Hydraulics & Pneumatics

SEPTEMBER 1960

VALVE DESIGN FOR COMBINE LEVELING

UMP SAVES MINING MACHINE SPACE

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313 NORTH FIRST ST INC
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MOBILE EQUIPMENT HYDRAULICS

A DESIGN PRIMER

CONTROL OUTRIGGERS WITH EIGHT VALVES OR ONE

see contents page 3

HOW TO USE A PRIORITY VALVE

HOW WE DESIGNED FLUID MOTORS INTO OUR MACHINE

THE MAGAZINE OF FLUID POWER

AN INDUSTRIAL PUBLISHING CORPORATION MAGAZINE

Plan to attend: National Conference on Industrial Hydraulics
Fluid Power Society Annual Meeting
see page 51 for details

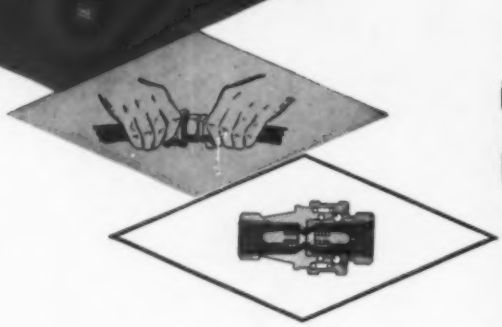
HANSEN

SERIES HK QUICK-CONNECTIVE

TWO-WAY SHUT-OFF

COUPLINGS

As easy as plugging in your electric shaver...



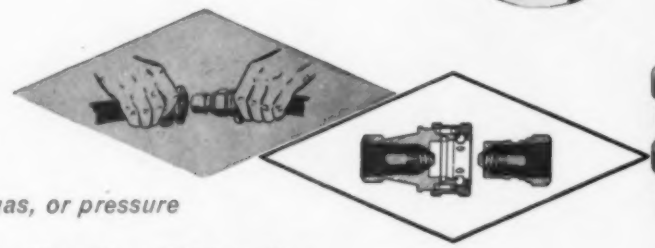
QUICK CONNECTION

with instant automatic flow

QUICK DISCONNECTION

with instant automatic shut-off

...prevents loss of liquid, gas, or pressure



To connect a Hansen Two-Way Shut-Off Coupling, you merely pull back the sleeve and push the Plug into the Socket. To disconnect, just pull back the sleeve. No tools required. When Coupling is disconnected, similar valves in Socket and Plug shut off both ends of line — practically eliminate spilling of liquid or escape of gas at instant of disconnection.

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Representatives in Principal Cities ...see Yellow Pages

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Sizes ¼", ⅜", ½", ¾"
Temperatures to 250°F

Air, Oil, water operation to 250 psi
Sizes ¼", ⅜", ½", ¾"
Temperatures to 250°F

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Include solenoid, pilot, hand and foot operated types

FOR AIR • OIL • WATER • OTHER FLUIDS

REGULATING cylinder speeds or controlling fluid flow of air, oil or water is so simple with Hanna Flo-Set Valves . . . you need only turn the valve body one revolution to adjust from zero to full pipe capacity. Micrometer-type graduations are numbered to indicate the percentage of pipe capacity. Once set, the position can be locked to avoid accidental change. Future resetting to a predetermined flow requires no guesswork.

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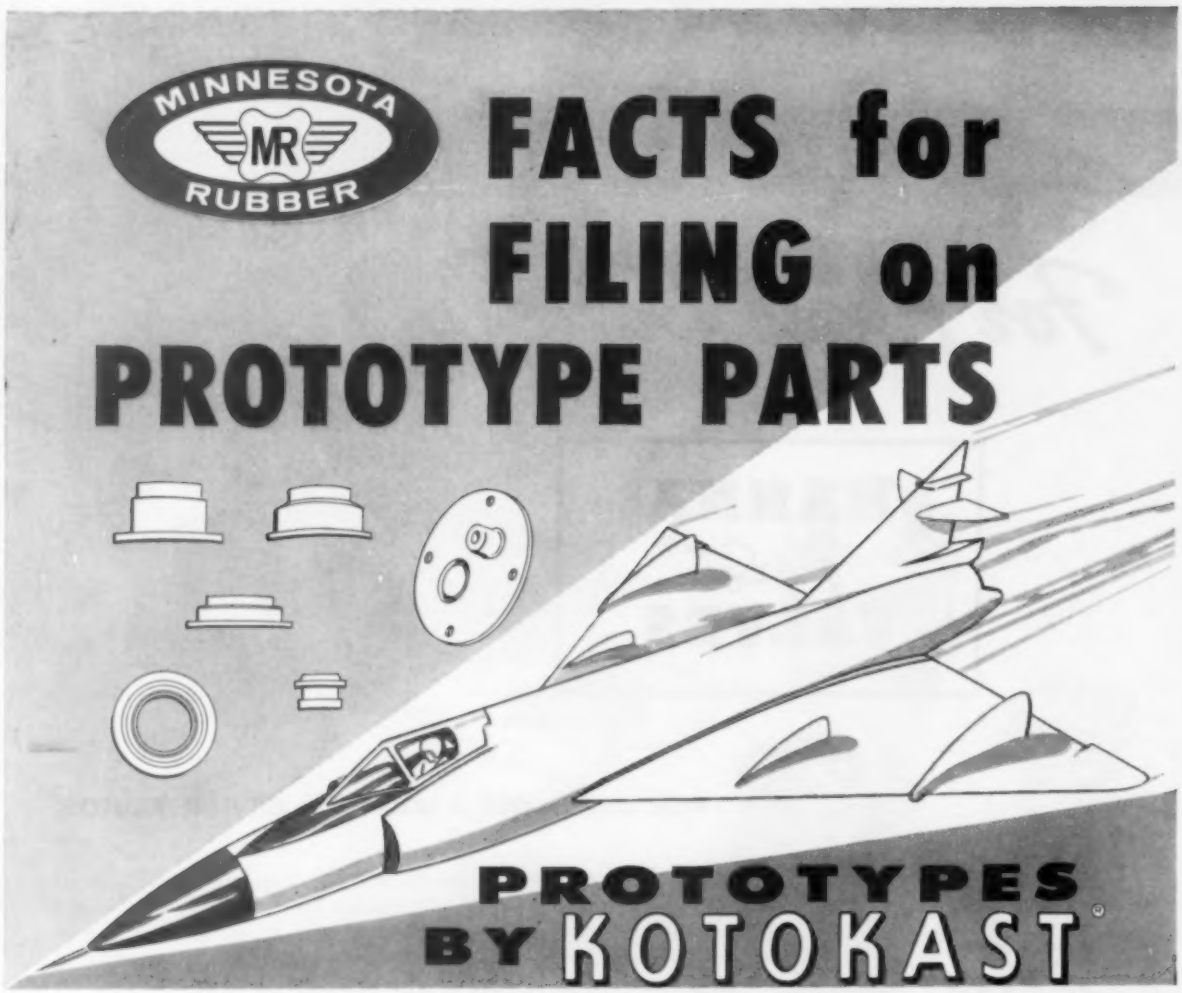

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Hydraulics & Pneumatics

VOLUME 13/NUMBER 9

SEPTEMBER 1960

THE MAGAZINE OF FLUID POWER

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Along the Aisles at the Production Engineering Show 74

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Up to 60 G.P.M.

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Available with or without By-Pass Valve.

For use with regular petroleum base Hydraulic Oils, Coolants, Lubricants and all types of Fire-resistant Hydraulic Fluids.

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For use with regular petroleum base Hydraulic Oils, Coolants, Lubricants, all types of Fire-resistant Hydraulic Fluids and Water.

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PIPE SIZES:
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BY-PASS VALVE:
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For use with regular petroleum base Hydraulic Oils, Coolants, Lubricants, all types of Fire-resistant Hydraulic Fluids and Water.

Bonded LINE TYPE

CAPACITIES:
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PIPE SIZES:
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BY-PASS VALVE:
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OPERATING TEMPERATURES:
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AH-8

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Series 1617-A A.C. 4-Way Solenoid Valves

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- Very fast cycling permissible
- No dynamic seals—packless
- High capacity—low pressure drop
- Compact—light in weight
- For pressures to 3000 p.s.i.
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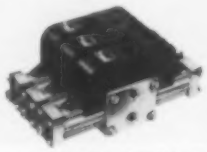

Designed for simplified stacking or banking

Here it is—the new pace-setter in A.C. solenoid valves! Exclusive Waterman design has eliminated inrush current, making possible fast cycling (in excess of 250 per minute) without overheating. Standard coils suitable for 25 to 60-cycle current. Weight of ⅜" size is less than 6 lbs., including two solenoids. Closed-center, tandem, and two-position types available. Rated 3000 p.s.i. pressure may be applied to all ports. Working parts totally immersed in hydraulic fluid. No moving seals—packless. Screw-type electrical terminals in steel housing. Also furnished for D.C. operation.

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THE MAGAZINE OF FLUID POWER

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USEFUL LITERATURE

ANCHOR INTRODUCES NEW DISTRIBUTOR CATALOG

In line with its new and broader distributor policy, Anchor Coupling Co. Inc. has recently issued a new Catalog D-1, exclusively for distributor circulation, that covers the entire Anchor Reusable Hydraulic Coupling, Hose and Fitting line that is available to users through Anchor's distributor organization.

This expanded distributor operation is designed to provide a quicker, more convenient service for the present and potential users of Anchor Couplings and Fittings. Distributors are carrying a complete stock of Reusable Couplings, Hose, Adapter Unions, Adapters, Pipe Fittings, SAE Boss Fittings and SAE 4-Bolt "O" Ring Flanged Head Couplings that can be made quickly available as required by local customers, both as parts or in hose assemblies.

The new Distributor Catalog No. D-1 describes Anchor's complete Reusable Coupling Line for high, medium and low pressure service with complete specifications, dimensions and assembly instructions for the various types of couplings.

The following reusable coupling styles are to be made available through this expanded distributor program.

Anchor High, Medium and Low Pressure Reusable Couplings for Style "C" 2-Wire Braid Hose and Style "F" 1-Wire Braid Hose.

Anchor Duloc Couplings for Style "QW" (1-Wire Braid, Cotton Covered) and Style "QWR" (1-Wire Braid, Rubber Covered) Hose for Medium and Low Pressure.

Anchor Reusable Couplings for HI-BURST and Standard 2-Rayon Braid Hose.

Anchor Clamp-Type Couplings for high pressure, Style "C" 2-Wire Braid Hose, Style "CC" 2-Heavy Wire Braid Hose, Style "CX" 3-Wire Braid Hose and for medium and low pressure, Style "F" 1-Wire Braid Hose, "HI-BURST" 2-Rayon Braid Hose, Style "SW" Spiral Wire Suction Low Pressure Hose.

Anchor Hold-Fast Low Pressure Couplings for 1-Cotton Braid Hose.

Anchor 4-Bolt Split-Flange "O" Ring Flanged Head Clamp-Type Couplings.

Anchor High and Medium Pressure Grease Hose Assemblies.

In addition, Anchor offers a complete line of adapters, Adapter Unions, Pipe Fittings and SAE Boss Fittings.

Write Anchor Coupling Co. Inc., 356 No. Fourth St., Libertyville, Ill. for the name of your nearest Anchor distributor, who will be glad to forward a copy of this new Catalog D-1 at your request.

ANCHOR®...THE PLEDGE OF PERFORMANCE

IN HYDRAULIC TRANSMISSION LINES

Failure in a fluid power transmission line is usually costly, with expensive equipment down, production delays and idle manpower until repairs can be made.

To hold such breakdowns to a minimum, Anchor has not only established rigid quality standards to which all Anchor Hydraulic Hose Assemblies must conform, but makes frequent tests and inspections of materials and workmanship to ensure conformity to these high standards.

Because of this, the Anchor emblem on any piece of hydraulic equipment is a real "pledge of performance" and service.

Andy Anchor says:

"Visit our Booth 155 SAE's Farm, Construction and Industrial Machinery Engineering Show, Sept. 12-15, Milwaukee, Wis."

ANCHOR HOSE ASSEMBLIES with ANCHOR Pressed-On Couplings are available for high, medium and low pressure service with maximum working pressures ranging from 12,500 PSI for 3/16" I.D. 6 Ply Super Spiral Hose to 100 PSI for 2" I.D. Spiral Wire Suction Hose.

ANCHOR REUSABLE COUPLINGS — Regular or Clamp Type, are available for emergency repair and year-to-year superior performance for high, medium and low pressure service ranging from 5000 PSI for 1/4" I.D. 2-Wire Braid Hose to 100 PSI for 2" I.D. Spiral Wire Suction Hose.

ANCHOR 4-BOLT SPLIT-FLANGE "O" RING HEAD COUPLINGS are available in a wide range of sizes for high, medium and lower pressure applications.

ANCHOR ADAPTER UNIONS, PIPE FITTINGS, SAE BOSS TYPE FITTINGS A complete line of Pipe and Tube Fittings, Adapter Unions and SAE Boss Type Fittings are offered in a variety of styles and sizes to satisfy the requirements of any installation.

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355 North Fourth Street, Libertyville, Illinois

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Now *reading accuracy* in keeping with *instrument accuracy*

The development of the "Master-test" series brought industry pressure gauges of almost incredible precision ... gauges individually dead-weight tested ... gauges guaranteed accurate within ¼ of 1% of full scale reading.

But this extreme accuracy would have been meaningless unless the gauge could be *read accurately*—unless some means were provided for sighting the scale "dead on."

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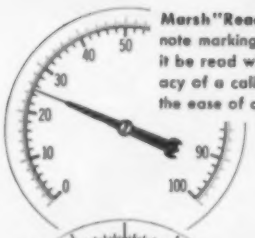
The Twin-tip has been declared a real innovation by all who have seen it. In addition to the "Twin-tip", "Master-test" gauges are also available with a Mirror Scale or with a "Non-parallax" scale which also provide reading accuracy in keeping with gauge accuracy. To make reading still easier all "Master-test" gauges have the "Read-easy" scale, illustrated opposite—another Marsh development.

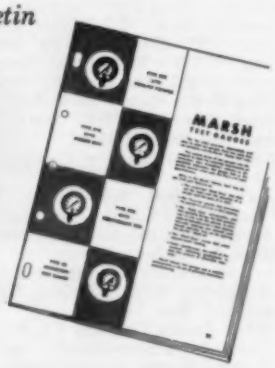
"Master-test" gauges are made in sizes 4½", 6", 8". All standard ranges from 0-15 to 0-30,000 psi. Vacuum and compound types. Full range of case patterns.



Marsh "Read-Easy" Dial note markings that permit it be read with the accuracy of a caliper, yet with the ease of a clock.

Conventional Dial markings are crowded in—hard to read.

Ask for this 20 page bulletin



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Division of Colorado Oil and Gas Corporation
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Fluid Power news

REPORT NO. 11,707 NEW HOPPER DREDGE USES OILGEAR EXTENSIVELY

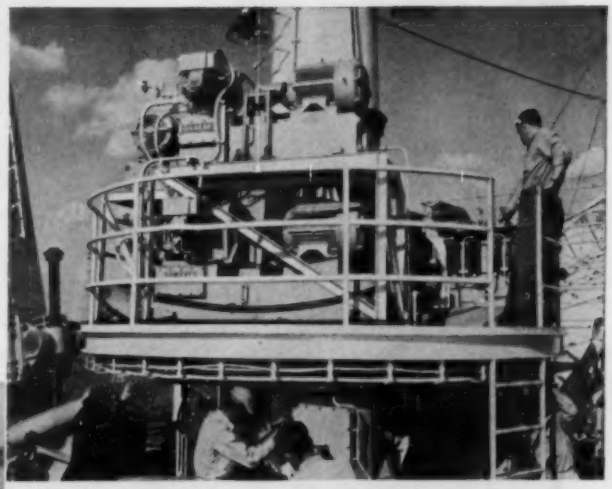
From Oilgear *Application-Engineering* Files

HOW OILGEAR HEAVY-DUTY ELECTROHYDRAULIC POWER AND CONTROL SYSTEMS SERVE OVER 125 APPLICATIONS ON SEAGOING HOPPER DREDGE *"MARKHAM."*

USER AND DREDGE DESIGNER: *U. S. Army Corps of Engineers*

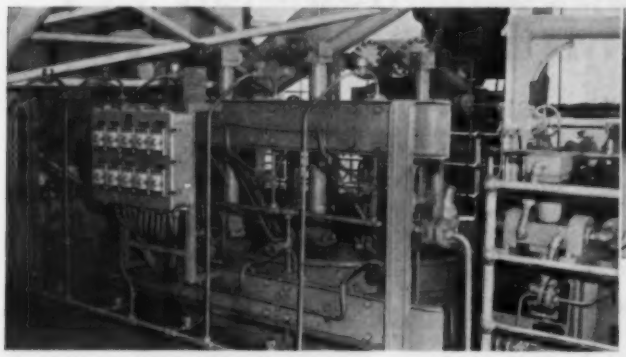
BUILDER: *Avondale Marine Ways, Inc., New Orleans, Louisiana*

The **"MARKHAM"**—constructed in accordance with A.B.S. and U.S.C.G. requirements, and largest suction dredge for Great Lakes harbor and channel maintenance—has Servocontrol Valve-equipped Oilgear Drives on Post Crane—Main, Whip, Topping Hoists and Rotating Machinery; and Anchor Windlass. Two Cargo Winches have Oilgear servo-motor lever hand-controlled drives. Oilgear Pumps, Cylinders, and Valves operate twelve 24-in. pump room valves, thirteen jetting valves, three sea valves, brakes and clutches on drag winches, forty mixing well gates, eight hopper dump gates, eight hopper distribution nozzle gates, and two gas collecting system valves . . .
over 125 Oilgear Power and Control applications.

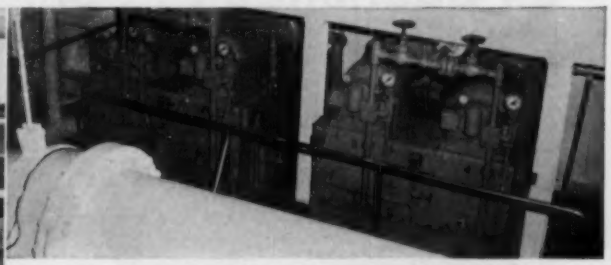


Post crane, with long boom, features remote, manual-controlled, Servocontrol Valve-equipped Oilgear Drives for all functions. Main hoist drive has a "DV-20" Pump and "H-20" Motor to handle loads to 20,000 lb at any speed up to 25 fpm. Whip hoist drive has a "DV-20" Pump and "H-20" Motor to handle loads to 4,000 lb at any speed up to 125 fpm. Topping hoist has a "DV-35" Pump and "H-20" Motor to raise full-loaded boom in 2½ minutes. Rotating drive with "DV-35" Pump and "H-20" Motor turns full-loaded crane 360° at ½ rpm. All drives are capable of handling a 50% overload. Manual operating levers, pushbutton stations, drive pressure gages, and pump stroke indicators are on a central control console.

Seagoing Hopper Dredge *"MARKHAM,"* launched June 10, 1959, is 339'6" long, has a 62' beam and 28' draft amidships. Hopper capacity—2,680 yards. Loaded Displacement—7,700 tons. Capable of dredging to a depth of 43'6", this diesel-powered vessel has a rated speed of 13 mph fully loaded, and 14½ mph light. The keel was laid at *Avondale* on July 29, 1958.



One of the four mixing wells—ten Oilgear double-acting cylinders operate the gates for each well. Oilgear trunnion cylinder, at right, operates distribution nozzle gate. Oilgear *"Power-Paks"* supply fluid power for operating over 100 cylinders. Two cargo winches on the forward deck feature Oilgear *"Any-Speed"* Drives manually controlled from the forecastle deck. Each winch uses an Oilgear "DH-4" Pump and "H-8" Motor Drive to lift 3,200-lb. loads at any speed up to 50 fpm.



Two Oilgear *"Power-Paks"*—one is a "stand-by"—supply fluid power for operating over 100 cylinders that actuate 6 drag winch brakes, 8 drag winch clutches, 30 valves, and 56 gates. Each 600 gallon reservoir mounts two Oilgear "CG-60" Constant Displacement, Radial Piston Pumps and their electric drive motors. Each pump delivers 67.2 gpm at any pressure up to 1750 psi. The Anchor Windlass also features a Servocontrol Valve-equipped Oilgear Drive with manual control unit located on the forecastle deck. An Oilgear "DV-60" Pump and "H-60" Motor Drive (not shown) handles two 7,000-lb anchors simultaneously at any speed up to 5 fathoms per minute. An electric brake on the Oilgear Motor tailshaft is interlocked with the pump control.

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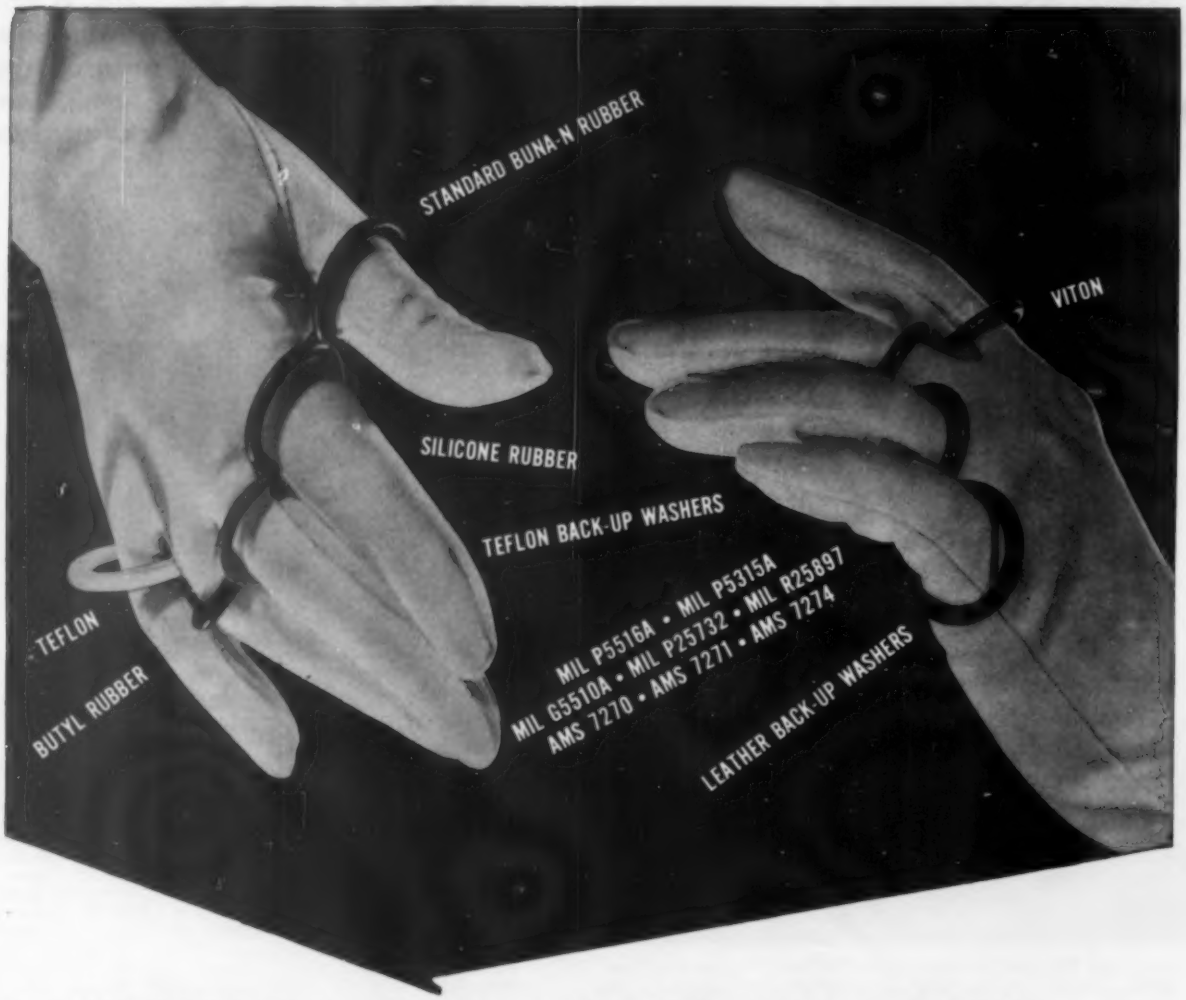

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Pressures: to 1500 psi
Operating speeds: to 2400 rpm
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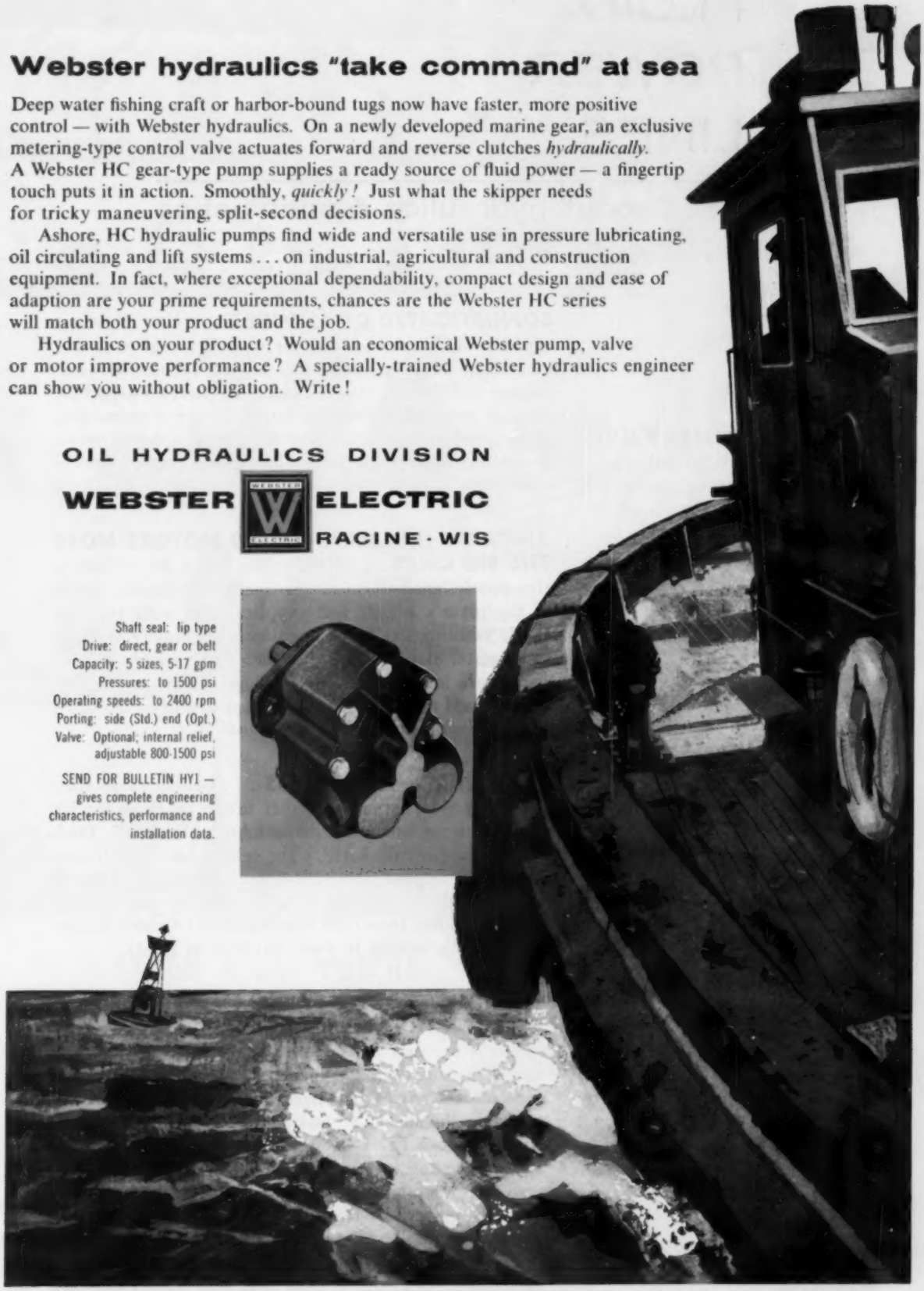
Valve: Optional; internal relief, adjustable 800-1500 psi

SEND FOR BULLETIN HY1 — gives complete engineering characteristics, performance and installation data.



PLEASE STOP IN — BOOTH 400 — SAE ENGINEERING DISPLAY, MILWAUKEE.

FLUID POWER LINES

about hydraulics & pneumatics

MOBILE EQUIPMENT HYDRAULICS . . . What makes hydraulic systems on mobile equipment different than on in-plant production machines? Many design factors make mobile equipment hydraulics a field by itself. The pump's drive is usually a variable speed engine, either the vehicle's engine or an auxiliary one, rather than a constant speed electric motor. Space is precious, so reservoirs must be integrated with the vehicle and are usually smaller relative to pump capacity than on industrial equipment. Valves are usually manually operated and are grouped either in one housing or by stacking separate sections for easiest control by the operator.

Starting in this issue, is a "course" of articles on mobile equipment hydraulics. The introductory article lays the groundwork for this series, giving basic design considerations and pointing out numerous examples of how hydraulics is doing the job in farming, mining, material handling, road building, and construction.

SOPHISTICATED COAL MINER . . . You might not expect to find sophisticated hydraulics in a coal mine, but modern mining machines use highly engineered components and circuits. One machine, described on page 110, uses an overcenter pump to supply drive motors. This gives speed and direction control without a 4-way valve. A special rotary valve ports flow to the pump's control cylinder.

AIRCRAFT HANDLING—FLUID MOTORS MOVE THE BIG ONES . . . Rather than tow a jet airliner, a recently designed wheel mover connects hydraulic motors to the plane's wheels and supplies them with pressure fluid. Boosting itself up on casters, the supply truck is then pulled along by the airplane. Two variable volume pumps are interconnected through valve circuitry to supply the fluid motors. The equipment is described in *Closed System Hydraulics for Aircraft Handling.*

BEACHHEAD HYDRAULICS . . . Getting cargo from a landing ship, through the surf to the beach is the job assigned to the 5-ton amphibious LARC. (Hydraulic Feedback Helps Steer the LARC) The vehicle has two cylinders for each of its four wheels. It steers with (a) front wheels only, (b) all four wheels in radial steering (rear wheels turning opposite from front wheels), or (c) 4-wheel oblique (rear wheels turning in some direction as front).

MEET TOBI GOLDOFTAS . . . Added to the H & P masthead this month is our new associate editor. He brings a background in mobile equipment hydraulics especially suited to the theme of this issue. His experience has been in design and project engineering at International Harvester and J. I. Case and has worked on tractor power steering and design of manifolding, reservoirs, and valves. Tobi holds a master's degree in agricultural engineering from Michigan State University.

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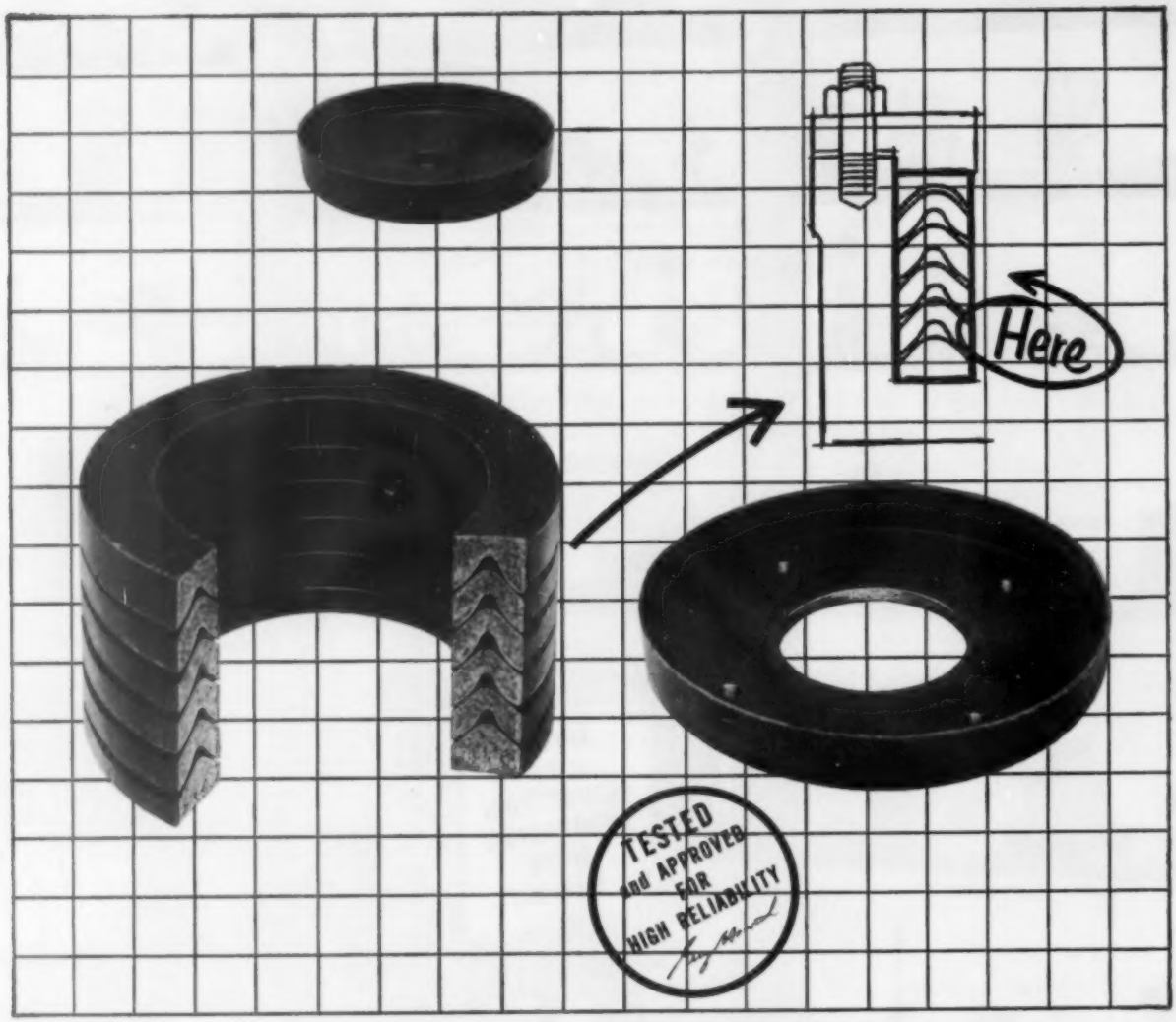

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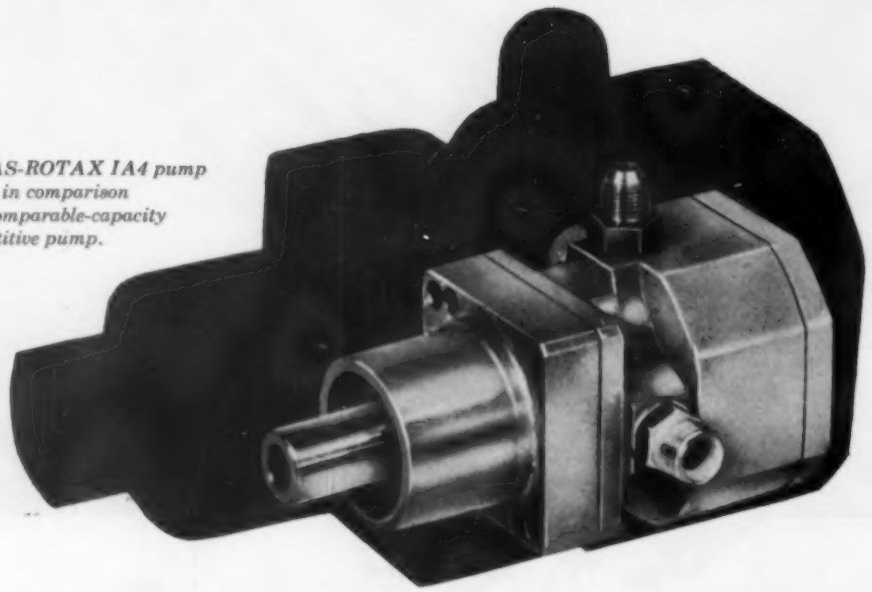

LUCAS-ROTAX IA4 pump shown in comparison with comparable-capacity competitive pump.

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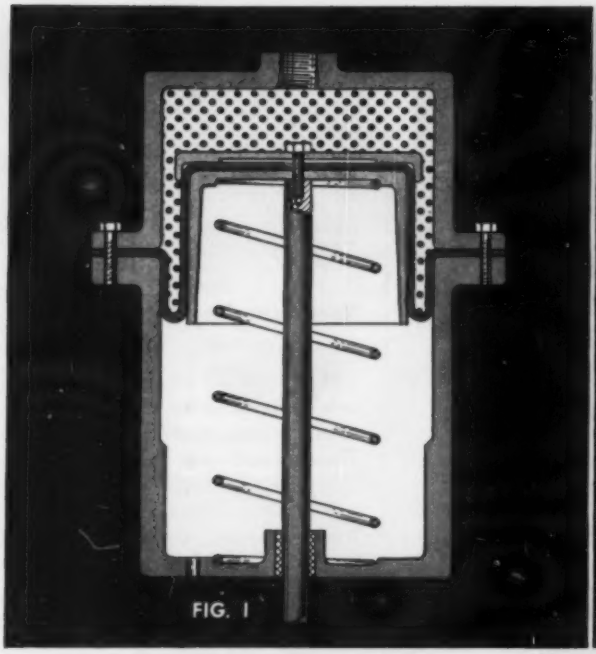

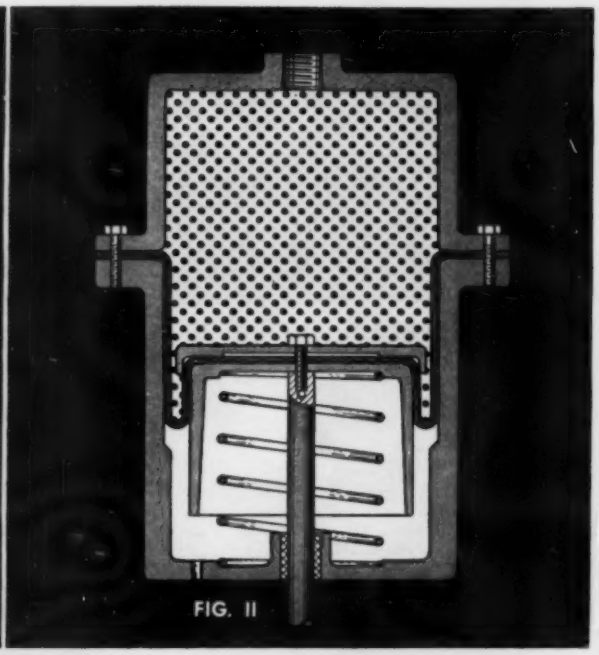

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The Bellofram Rolling Diaphragm provides ultra-sensitive response in hydraulic or pneumatic devices where frictionless, long-stroke action in small diameter configurations is required . . . and where flex life of millions of cycles is necessary.

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Fig. I shows how Bellofram Rolling Diaphragm conforms to the piston. Fig. II shows how, as the piston descends under pressure, the Bellofram Rolling Diaphragm *rolls* off the piston's sidewall and onto the cylinder's sidewall in a smooth, continuous, frictionless movement.

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2. **No break-out friction effects.**
3. **Non-porous and leakproof.**
4. **Constant area in all piston positions.**
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7. **No mechanical spring gradient.**
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9. **Automatic de-icing action.**
10. **Free positioning with complete relaxation at any point in the stroke.**
11. **Does not require close machine finish tolerances on pistons and cylinders.**
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13. **One hundred stock sizes. Four mounting configurations. Special types and sizes designed to order.**
14. **Excellent temperature stability from —85°F. to 550°F. (from —120°F. to 700°F. in some cases). Wide range of working pressures: 1 inch H_2O to 500 psi (up to 1200 psi in some cases). Effective pressure areas from .028 to 108 square inches. Cylinder bore diameters from .25 to 12 inches. Extended range of stroke (.01 to 12 inches).**

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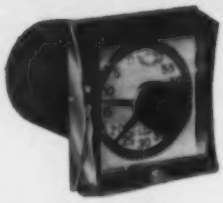

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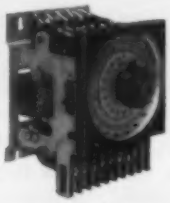

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LETTERS to the editor

Address your letters to: Editor, HYDRAULICS & PNEUMATICS MAGAZINE, 812 Huron Rd., Cleveland 15, Ohio.

Needs service manuals

TO THE EDITOR:

We would like to get some manuals or specification sheets for hydraulic pumps, motors, and valves. These should give tolerances for rebuilding the units.

We use your magazine and find it of great value. We are interested in new component ideas as they come on the market, and we find your articles of great use to learn about new designs. If you could be of service in the above request, we will greatly appreciate it.

JOHN L. MICHALEC, Partner
John The Jack Man Co.
Stafford Springs, Conn.

We suggest you contact manufacturers of these components directly. Each manufacturer would have to give you these specifications for his own products. Thank you for your kind words on HYDRAULICS & PNEUMATICS. *We're pleased that it is valuable to you in your work.*

Foreign component?

TO THE EDITOR:

We would like to ask you about the address of the hydraulic pump, motor and valve manufacturer *Energy*. We have seen this equipment on the *Vermeer* ditch machine.

R. AFFOUARD
L'Equipment Hydromecanique
Paris, France

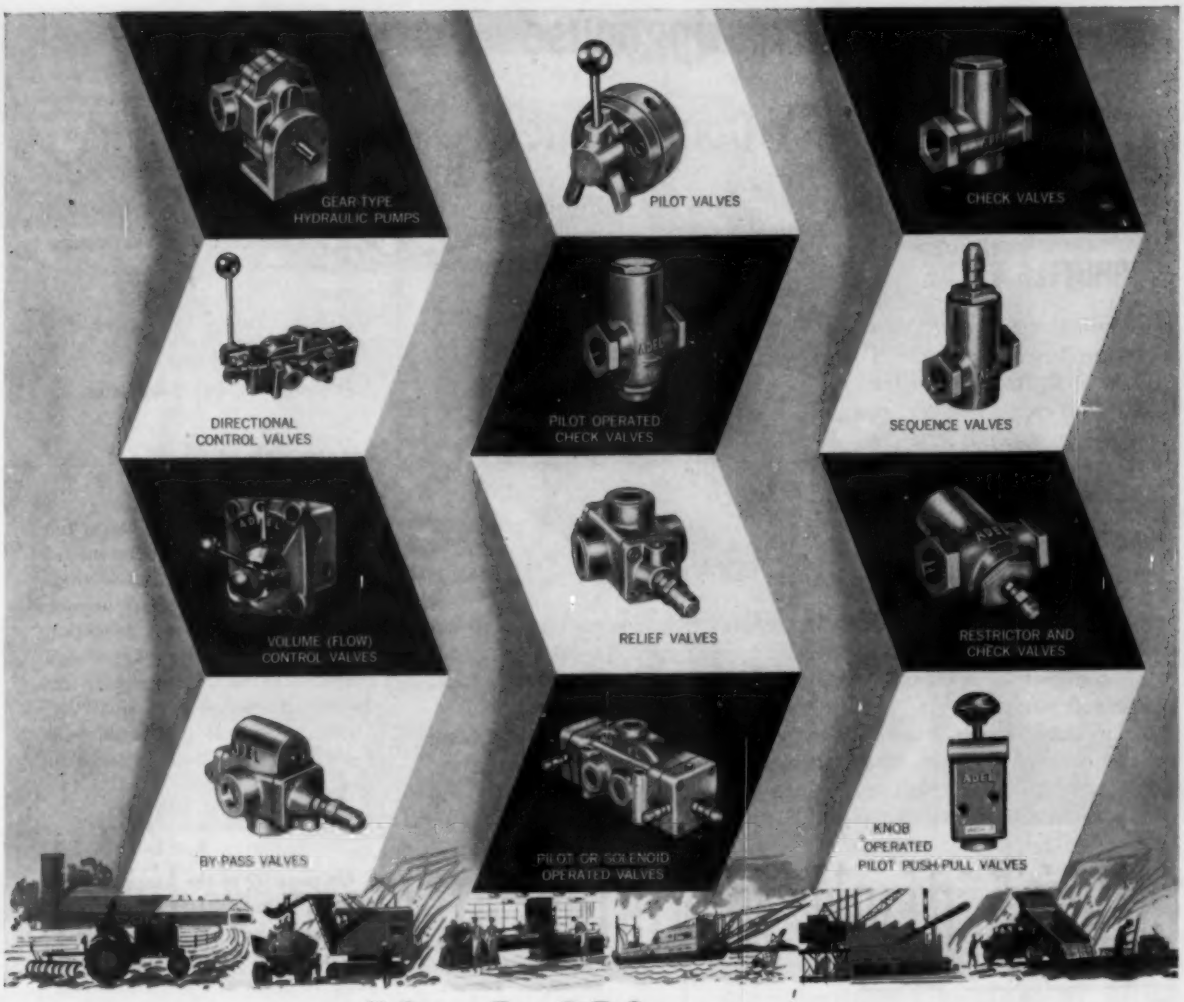
We cannot identify the manufacturer from this trade name. Perhaps one of our readers will be able to help?

High pressure reducing valves

TO THE EDITOR:

On page A/153 of the 1960-61 FLUID POWER DIRECTORY, reference is made to pressure reducing

Continued on page 20



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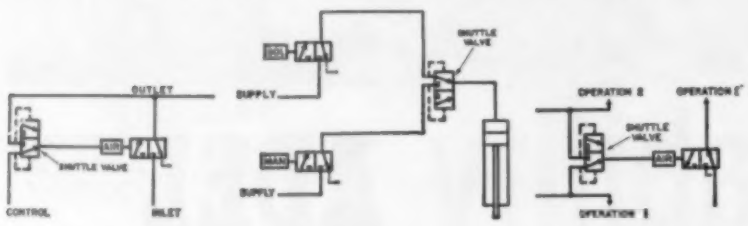

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Insures an operation is held constant once initiated. Outlet line must be vented by another means to unlock the system. ("Memory" Circuit)

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Either of two controlling devices may operate the cylinders. Inoperative controlling device is sealed from the line. ("Or" circuit)

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LETTERS

valves being used in high pressure water hydraulic systems. We would appreciate it if you would send us a list of companies that manufacture these valves. Thank you.

OTTO KREIS
Tubular Engineering Dept.
A. O. Smith Corp.
Milwaukee, Wisc.

Information has been sent.

Rotary actuators

TO THE EDITOR:

We are anxious to learn the names of any manufacturers of rotary cylinders. We are also anxious to get the names of anyone building hydraulic gear reduction units. To the best of my knowledge I saw a planetary type gear reduction connected to a small hydraulic motor. If you could help me with these names I would be most grateful.

C. H. AVERY
Avery Tractor, Inc.
West Lebanon, N.Y.

On page 92 *of the January* 1960, APPLIED HYDRAULICS & PNEUMATICS *issue, there is a list of manufacturers of rotary actuators. On page* 189, *there is a listing of addresses for these manufacturers.*

Needs gage connections

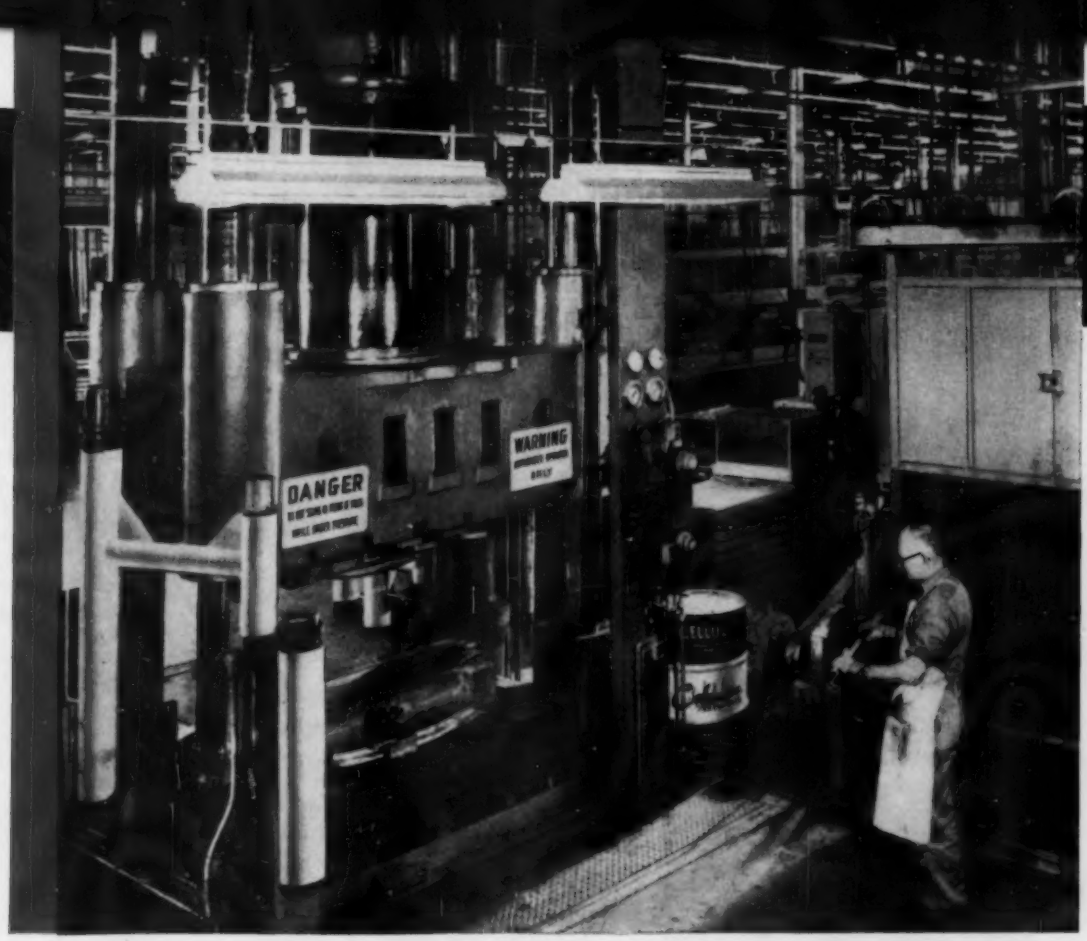
TO THE EDITOR:

If you are interested in stimulating new thinking on hydraulic systems and components, I would like to throw in the question "Why don't the manufacturers of hydraulic systems give a little more attention to the trouble-shooting of the system?" How many times we have wished that plugged tee-fittings were on both sides of a component, and we could remove the plugs and screw in pressure gages. It might not have told the whole story, but it certainly would have been a step in the right direction.

Some thought along this line would make the hydraulic manufacturer mighty popular in the maintenance man's book.

R. KNUTH
Falk Corp.
Milwaukee 1, Wis.

Circle 31 →



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where hydraulic presses handle titanium at 1000°F.

Hydraulic line breaks could be a serious fire hazard in this hot press-forming operation.

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Cellulubes, the *safe* hydraulic fluids, are available in six controlled viscosities: 90, 150, 220, 300, 550 and 1000 SUS at 100°F. You can select the viscosity best suited to your operations. Cellulubes may well make an important contribution to the safety of your plant and personnel. Write to us for more information about Cellulubes, and please let us know what application you have in mind.

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It not only saves on cost and weight, but also does a better job. Fluid pressure forces mating threads together, creates a still tighter seal, locks threads in place.

Metal-like mechanical properties of Delrin provide excellent strength, dimensional stability, rigidity. Count also on resistance to corrosion and solvents.

Available in ⅛, ¼, ⅜, ½" pipe sizes. Send for samples.

Ask about other parts you would like custom-molded from Delrin, or other thermoplastics, in production quantities.

Write Russell, Burdsall & Ward Bolt and Nut Company, Port Chester, New York.

*Du Pont trademark

RB&W
116th year

Circle **124** on Time-Saver Card

FLUID POWER FORUM

Each month HYDRAULICS & PNEUMATICS surveys readers for their experiences and opinions in fluid power design.

• *What features do you want in the ideal fluid reservoir? Can you get the features you need? What complaints do you have about present reservoirs?*

I want a reservoir whose construction reduces self-contamination. It should be easily mounted vertically or horizontally, and should have an end that can be opened completely, giving a large opening with easy access for complete, periodic cleaning. Furthermore, I want corrosion resistance, a filtered filler port, and a sight-glass that will withstand pressurization of the reservoir. I want adequate means for temperature control (heaters and coolers).

The reservoir must be anti-foaming and conductive to deaeration of fluids. I want to use it with antimagnetic air filters on inlet lines and with magnetic particle separation within the reservoir proper. Also desirable is a small sump portion into which foreign material will gravitate for draining through a plug.

I get these features by building my own reservoirs.

DOUGAL H. SIVER
Asst. to Manager of Engineering
Aircraft Hydraulics
The New York Air Brake Co.
Watertown, N. Y.

As machinery builders, we make about 90% of all the fluid reservoirs for our machinery. The ideal fluid reservoir features we want are special for fluid reservoir manufacturers. The reservoir should have baffling to give a fluid flow pattern for heat dissipation. There should be a lip on the top of the reservoir to collect small leakage from equipment mounted on the reservoir. There should be no pump and motor base and no filler and strainer assembly protruding out of the reservoir. The reservoir should be raised off the floor 3½" to 4" maximum, regardless of reservoir size.

These custom features built into a purchased reservoir would raise the price to a level at which we could design and fabricate these units for about the same cost.

Have reservoir manufacturers ever thought of making reservoirs out of aluminum?

MEL COCHRAN
Hunter Engineering Co.
Riverside, Calif.

• *What is your preference for cylinder packing (dynamic) for pistons and rods? O-rings, U-rings, V-rings, cups, flanges, piston rings, etc? Why? What problems have you had with packing? Material, size, shape, supply, leakage, etc?*

My first choice is U- or V-ring for zero leakage. Otherwise a cup with O-ring back-up.

I have had some trouble from impregnated fabric cups and rings.

SID TREMEWAN
Mgr., Development & Production
Western Conveyor Co.
Boise, Idaho

In general the O-ring is my first choice in most sealing applications whether dynamic or static. Their advantage is simplicity and standardization.

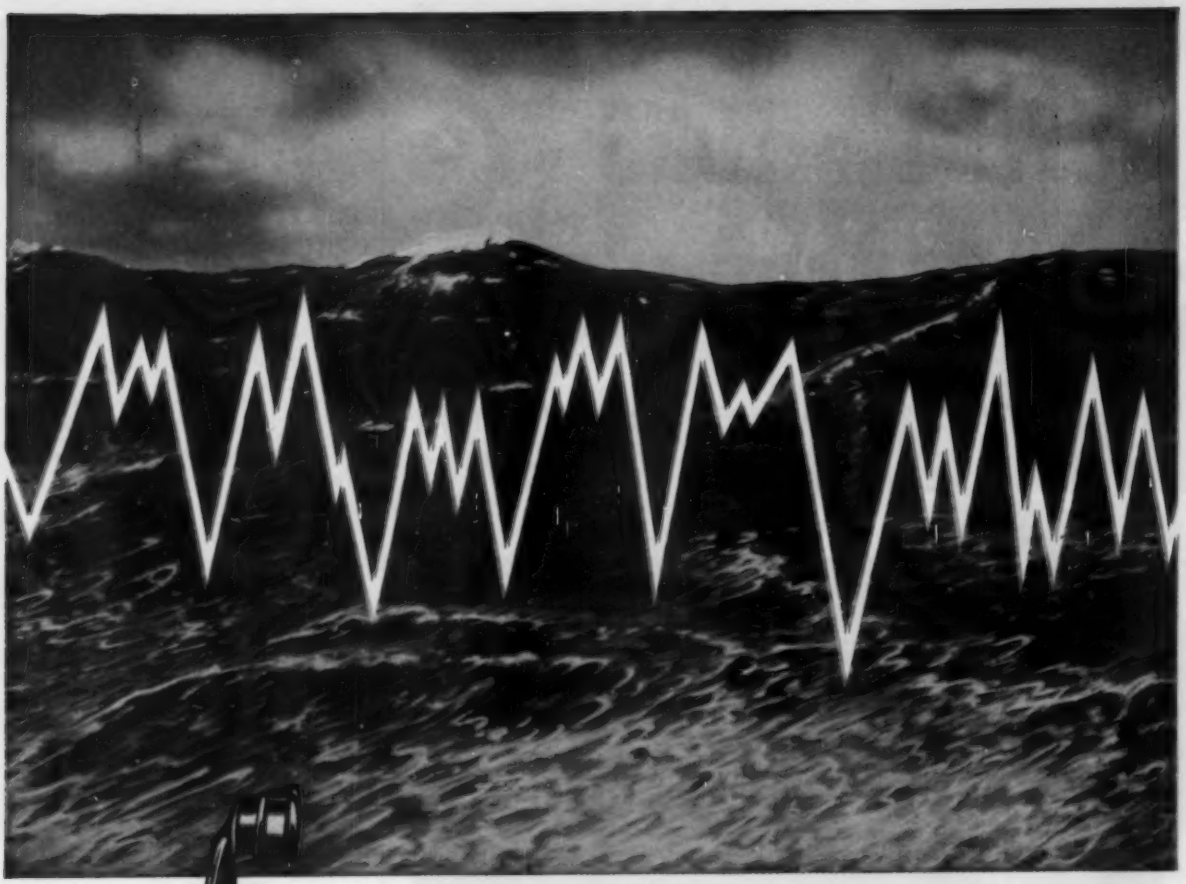
In dynamic applications I consider friction one of the greatest problems. The amount of friction depends upon pressure, temperature, and time.

R. LINSALATO
Accessory Products Co.
Whittier, Calif.

My experience has been with O-rings only, because the military specifications for projects on which I worked required O-rings.

We've had problems with materials. On several designs instead of swelling, the O-rings shrank when exposed to red hydraulic oil.

Continued on page 24



Telecommunications

Two recent major steps in the improvement of world telecommunications have been the laying of the first Trans-Atlantic and the California–Hawaii submarine telephone cables.

When laying cable either on a flat sea bed or over underwater mountain ranges, the exact control of paying out speed and tension in the cable is of paramount importance. 'VSG' variable delivery oil hydraulic pumps are used to act as brakes on the cable, which is drawn out of the ship by its own weight. This enables a very smooth and regulated control to be maintained or instantly varied to suit ship speed, paying out speed and tension in the cable.

It is just another of the highly varied applications of 'VSG' variable delivery pumps and transmission gears which have now been serving modern industry for over fifty years.

'VSG' *Regd Trade Mark*

SERVING MODERN INDUSTRY

VICKERS ARMSTRONGS (ENGINEERS) LTD VICKERS HOUSE BROADWAY LONDON SW1

NEW NEW NEW NEW NEW NEW

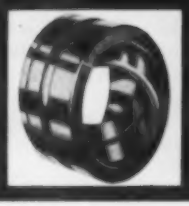
NOW! 1½ TONS PER SQUARE INCH CONTINUOUS RATING

*Tested at 2½ tons per square inch

Pathon
3000 PSI
HYDRAULIC CYLINDERS

The New Pathon Series 3H Hydraulic Cylinders are not an adaptation or modification of existing models, but specially designed 3000 P.S.I. Cylinders, continuous service. The 3H Series is available in a wide range of bore sizes and standard mounting types. Like all other Pathon Cylinders, the 3H Series features:

- Single screw thread head attaching method
- Increased strength and fatigue life
- Low Stress Concentration
- Compactness



Illustrated, Model 3H 33 incorporating spherical bearing at the pin connection.

FOR ADDITIONAL INFORMATION
WRITE—WIRE—PHONE TODAY

Pathon MANUFACTURING COMPANY
3823 PACIFIC AVE., CINCINNATI 12, OHIO

FLUID OPERATED AND CONTROL EQUIPMENT

FORUM

Leakage is generally a result of poor design or abrasion caused by foreign matter.

D. NORTHSTINE
Hydro-Mechanical Systems Engineering
McDonnell Aircraft Corp.
St. Louis, Mo.

● *JIC Standards now approve welded tubing. How will this affect your designs for cylinders and lines?*

Practically all the work in this district which utilizes hydraulic power requires either an extremely long life, say in the order of fifty years, or an extremely high degree of dependability, and quite possibly both. The hydraulic features are usually an extremely small portion of the job from the cost standpoint, and savings are not considered to be particularly important compared to dependability. Therefore, unless the national defense picture makes it necessary, it is expected that this district will continue to specify seamless steel tubing for both operating and pilot pressure lines.

As regards cylinders, this office usually designs its own cylinders in the larger sizes, above 6″ or 8″ and shows them as castings. We will normally accept circumferential welds to join flanges to large (10″-14″) seamless tubing, but will not accept longitudinal welds. Small cylinders are preferred to be seamless, and will usually, if not always, be specified that way.

JOSEPH HARZ III
Mechanical Engineer
U.S.A. Engineer District
Vicksburg, Miss.

No effect because I shall continue to use seamless tubing on high pressure installations. I am not convinced the savings is worthwhile. Comparable tubing should have all welded joints X-rayed or checked by other means. In my opinion you are relaxing in safety.

P. P. DAY
Mechanical Engineer
Taylor Model Basin
Washington 7, D. C.

Circle 106 on Time-Saver Card

Circle 152 →

ACTUAL SIZE

WATTS No. 608

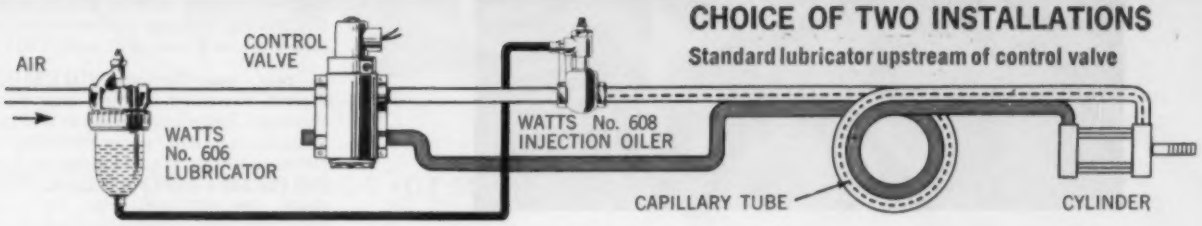
1/4"-3/8"

AIR CYLINDER INJECTION OILER

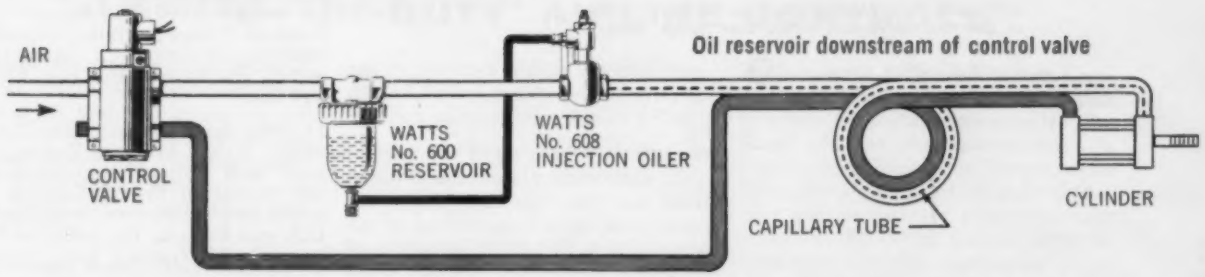
Solves the problem of lubricating low volume, short stroke cylinders

CHOICE OF TWO INSTALLATIONS

Standard lubricator upstream of control valve



Oil reservoir downstream of control valve



Most low volume, short stroke air cylinders are impossible to lubricate properly by ordinary mist-type lubrication because of their low air consumption.

The solution is *controlled* oiling—*direct to the cylinder*. It's the *only* way to assure positive lubrication for long cylinder life.

Installed in the pressure line between control valve and air cylinder, Watts' new No. 608 Injection Oiler is designed specifically to deliver metered oil direct to the cylinder through a capillary tube located within the cylinder air supply line.

Find out about the Watts Injection Oiler. Available in kit form (K608), includes No. 608 oiler, 2 ft. oil supply hose and 16 ft. capillary tubing.

Write *Watts Regulator Company, Industrial Division, Lawrence, Massachusetts.*

VISIT US AT BOOTH 355
PRODUCTION ENGINEERING SHOW

WATTS

NYLON PRESSURE TUBING

for Hydraulic-Pneumatic Service

CHEMISEAL Nylon Pressure Tubing can be flexed, twisted or bent into all contours, offers wide design "leeway."

Flex it . . . twist it . . . bend it! In fact, shape Garlock CHEMISEAL Nylon Pressure Tubing into practically any contour you need. Think what this means in design freedom and versatility.

For hydraulic-pneumatic systems, pressure lubrication lines, oil and fuel lines, vacuum system connections. Garlock CHEMISEAL Nylon Pressure Tubing is a superior design material. It is unaffected by oils, alkalies, hydraulic fluids, and many solvents that tend to corrode metal. It resists vibrational fatigue, abrasion, impact . . . withstands temperatures from −60°F. to +180°F. (can be heat stabilized for 300°F.) . . . available in 1000 and 2500 psi. grades, conforming to J.I.C. specifications. Diameters from ⅛" O.D. up to largest size commercially made, depending on customer needs.

To guarantee you best performance possible, CHEMISEAL Nylon Pressure Tubing is subjected to severe tests. For example, the Anvil Impact Test simulates the mechanical abuse that may accidentally occur in service. CHEMISEAL Nylon Pressure Tubing is placed on a flat steel anvil. A 16-pound hammer with a striking head of 6" drops freely onto the tubing from a height of 24". The Roll Bend Test assures freedom from defects which cause flex fatigue. Tubing is passed around and between two grooved rollers to form an "S" shape. Space between rollers is twice the diameter of the tubing. Tubing is then moved back and forth at a rate of at least 125 f.p.m.

In cost, too, Garlock CHEMISEAL Nylon Pressure Tubing has the advantage. Seamless copper and extruded aluminum cost approximately four times as much, while welded and seamless stainless steel costs 29 to 37 times more, respectively. Also, the cost of couplings and installation labor should be considered—CHEMISEAL Nylon Pressure Tubing needs no intermediate couplings or fittings . . . is simple to install. You save on first cost, fittings, and labor.

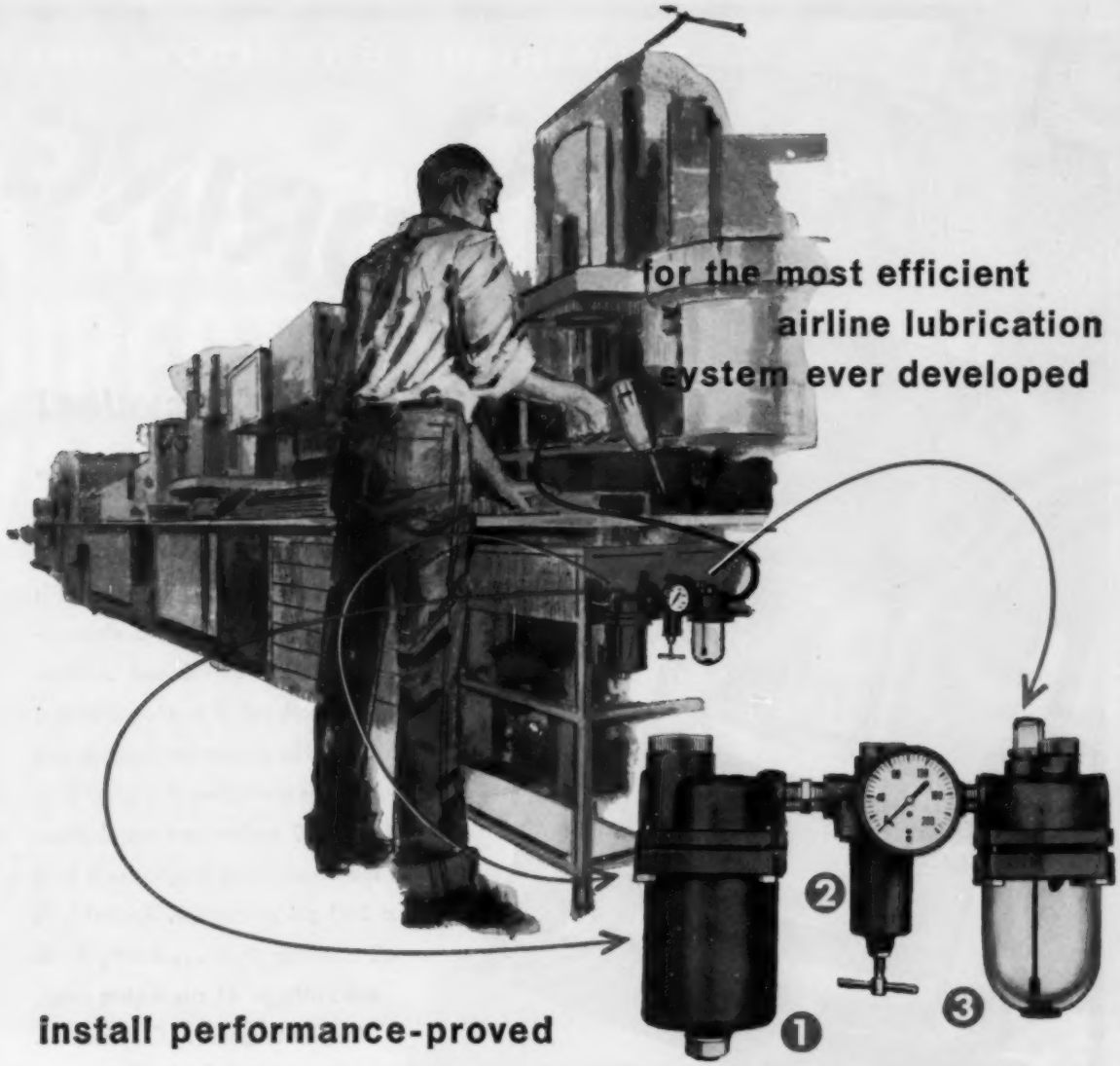
Discover how you can use CHEMISEAL Nylon Pressure Tubing. Call your local Garlock representative at the nearest of the 26 Garlock sales offices and warehouses throughout the U.S. and Canada. Or, write for Catalog AD-177. Garlock Inc., Palmyra, N. Y.

GARLOCK

Canadian Div.: Garlock of Canada Ltd.

Plastics Div.: United States Gasket Company

Order from the Garlock 2,000 . . . two thousand different styles of Packings, Gaskets, Seals, Molded and Extruded Rubber, Plastic Products



ALEMITE 'TRI-DUTY' AIRLINE CONTROLS

Complete Alemite package assures cleanest, driest, best-regulated lubrication of air tools, air cylinders, air motors, and many other types of air-operated equipment. Specifically designed for extensive service life and peak efficiency under adverse operating conditions!

1 Automatic Water Separator. Removes all of condensate, all the time. Traps dirt particles to prevent damage to sensitive airline devices. Handles all airline pressure up to 200 PSI and flow volume from 5 to 50 CFM.

2 New Air Regulator with Gauge. Assures accurately controlled air—prevents erratic operation and damage to equipment. Design permits inlet pressures of 250 PSI—adjustments up to 125 PSI. Excess air pressure "bleeds off," within regulator, instantly.

3 Automatic Airline Lubricator. Compensating ball valve design controls air flow. Oil particles are atomized for most efficient transmission through supply lines. Result—uniform mixture regardless of air pressure and volume. Oil and air mixture proportionately constant. Reservoir may be filled at any time, assuring continuous operation. Nine-ounce capacity.

Symbol of SW Excellence

ALEMITE DIVISION
STEWART-WARNER CORPORATION

1850 Diversey Parkway, Chicago 14, Illinois

Mail coupon for full details!

Alemite, Dept. EE-90
1850 Diversey Parkway, Chicago 14, Ill.

Please send me all the facts about Alemite's new "Tri-Duty" Airline Controls.

Name _____

Company _____

Address _____

City _____ Zone _____ State _____

NO SCORING

. . . after 25,000,000 cycles!

Alkon series D cylinders have exclusive nylon* piston bearings to prevent scoring, prolong cylinder wall and piston rod life. The secret is silky smooth nylon moving along a **chrome-plated steel cylinder barrel** and stainless steel piston rod, both roller burnished to a 4 micro-inch finish. No chance for scoring. Just slick, trouble-free operation, day after day, for 25,000,000 cycles and more! More facts: the Alkon Series D cylinder is built for 250 psi air service. Available in all mounting styles . . . **3-way flush mountings at no extra cost.** Exceed toughest J.I.C. standards. All are ready for immediate delivery with or without cushions.

The Alkon series D cylinder costs at least 25-40% less than any other comparable cylinder!

Alkon also manufactures compatible 4-way valves and pneumatic drill units.

Write for **new** free 24 page catalog

alkon
PRODUCTS CORPORATION
200 CENTRAL AVE. • HAWTHORNE, N. J.
HAwthorne 7-6633

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Circle **158** →

From WOOSTER Engineering...

A NEW FAMILY OF DIRECTIONAL CONTROL VALVES

B-W

OPERATING PRESSURES TO 2000 PSI

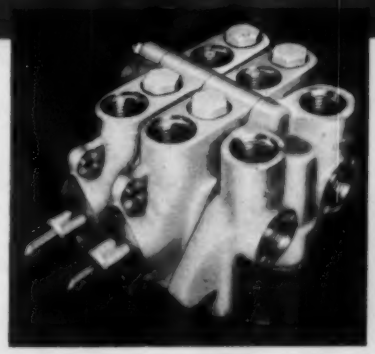
A VARIETY OF USES FROM A BASIC VALVE

Parallel circuit, open center, stack type with simple 3-bolt mounting. Built for heavy-duty service and long life in agricultural implements, materials handling, mobile equipment and industrial applications.

LIFTS—TILTS—POSITIONS

Series 20 Stack Type Valve

1. High tensile strength gray cast iron shell cored body with cast-in metering notches for positive feathering. Generous passages assure free flow at extremely low pressure losses.
2. Front cover W/ horizontal or vertical inlet and outlet ports . . .
   (a) W/ cartridge-type pilot-operated relief valve, or
   (b) W/O relief valve.
3. Rear cover . . .
   (a) W/ alternate outlet and high pressure carry-over port,
   (b) W/ alternate outlet port, horizontal or vertical, or
   (c) Plain W/O ports.
4. Switch valve to switch externally from 4-way to 3-way operation.
5. Spring center to neutral, or
   (a) Optional detent hold.
6. Hardened chrome-plated spool, fully balanced; double-acting, float or motoring optional.
7. Cylinder ports—SAE straight thread "O" ring fittings.
8. Closed center plug—optional.
9. Load check valve—optional.
10. Anti-cavitation check valve—optional.



Write, Phone or Wire Our Engineering Department. Watch for Announcement of Higher Capacities

B-W

WOOSTER DIVISION

BORG-WARNER CORPORATION, WOOSTER, OHIO

INDUSTRIAL HYDRAULICS / EXPORT SALES—BORG-WARNER INTERNATIONAL 36 SOUTH WABASH AVE., CHICAGO 3, ILL.

IT'S A BETTER PRODUCT WHEN BORG-WARNER HAS A PART IN IT

BRIEFS

about fluid power

Hydraulic Servo System Helps Test Jet Engines

An electrohydraulic servo-valve is called the "missing link" by Armstrong Whitworth Equipment Engineers in solving a major control problem for testing jet engines in a high altitude test cell.

The two-stage valve combines a pilot valve and a main valve. In the pilot valve an electrohydraulically actuated diaphragm controls oil flow from two jets. Pressure differentials caused by diaphragm motion move the main valve spool accordingly, controlling fluid flow to a hydraulic actuator.

The hydraulic actuator transmits electric feedback signals through a built-in potentiometer to open or close the valve. A second potentiometer gives an independent signal to an indicator on a remote control console.

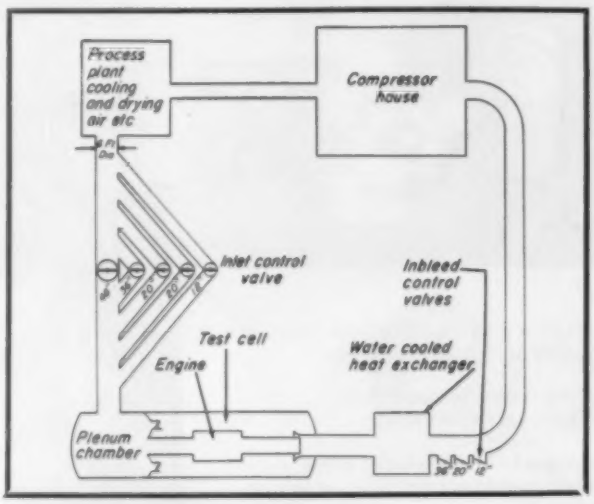
This valve-actuator combination forms the nucleus for a complex network illustrated schematically and simply in Figure 2. It consists of three main groups of valves, a test cell, heat exchanger, compressor and air cooler, and dryer.

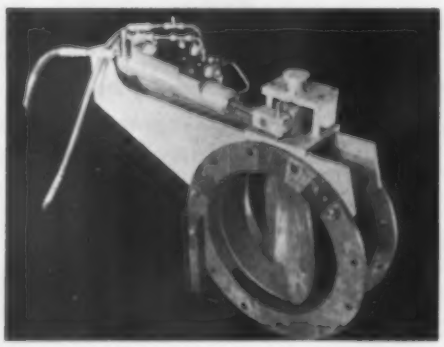
Five inlet valves regulate engine intake pressure chamber (plenum). Ten bypass valves control the air bypassing the intake (to simulate acceleration) and three inbleed valves control the supply of atmospheric air entering the vacuum between test cell and exhauster to keep a constant load on the exhausters. All 18 valves can be actuated manually, fully automatically, or programmed to open and close at a predetermined rate.

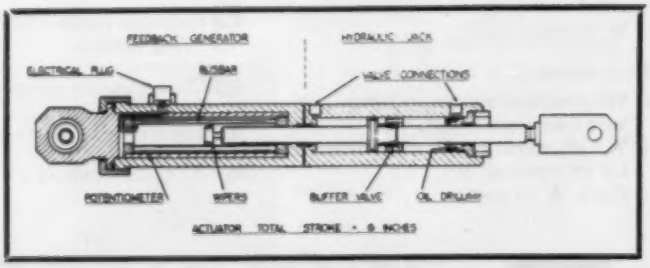
Air supply (250C to —70C) is obtained from electric centrifugal compressors arranged in series or parallel according to desired flow or pressure ratio conditions.

Each control unit incorporates the variations required for the different modes of control, and different rotation rates required of the butterfly valves they are associated with. ▼▼▼

Continued on page 32







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ONE MAN ONE TRADE ONE TOOL

...your production line back in operation in

30 SECONDS

(if it's a Hunt PDQ Air Control Valve)

☑ **accessibility** ☑ **simplicity** ☑ **speed and capacity** ☑ **price and quality**

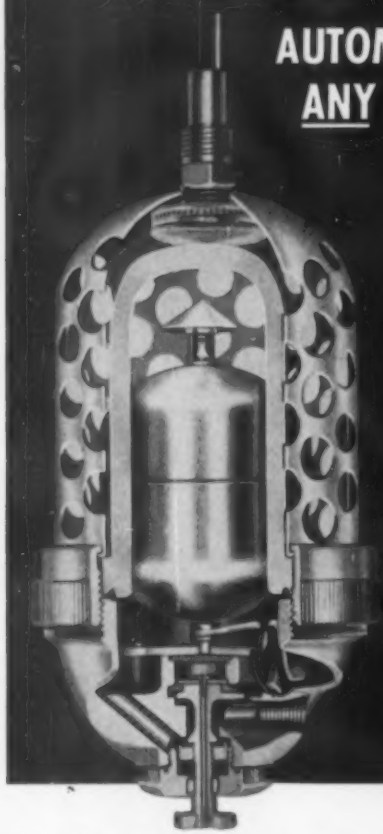
No bulletin can do it justice... have the Hunt man call. Write to:

HUNT HUNT VALVE COMPANY DIVISION OF IBEC SALEM, OHIO

Quick-As-Wink AIR & HYDRAULIC CONTROL VALVES

HYDRO-JECTOR

AUTOMATICALLY DRAINS ANY FILTER, DRAIN LEG OR SURGE TANK



- GUARANTEED minimum 1 year trouble-free operation
- ½" internal discharge port
- Connecting Nipple available in 3 sizes
- Discharges at rate greater than 300 gallons of water per hour at 125 PSI
- Drains oil as well as water
- Transparent *Visi-Bowl* permits visual inspection
- Operates on pulsating, continuous or no flow
- No air loss during dump cycle
- Vent Nipple prevents air lock
- Manual Plunger permits "clean-out" without disassembly

The *M/P Hydro-Jector* can be installed easily and quickly in the bottom drain port of *any* compressed air filter, separator, drain leg, water bottle, surge tank, air receiver tank or other water collecting vessel.

This is not an ordinary float operated trap. The *Hydro-Jector* incorporates unique pilot valving and large internal discharge passages.

Only M/P offers a one year guarantee against clogging.

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NEW AIR CYLINDER LUBRICATOR
For application in the *M/P Down-Stream Circuit*—a new M/P concept which assures reliable lubrication of even the smallest air cylinders.

SHATTER-GUARD
A new feature which makes the *M/P Visi-Bowl* as safe as a metal bowl. Available on all M/P Filters, Lubricators and Hydro-Jectors.

MASTER PNEUMATIC, INC.
20430 SHERWOOD • DETROIT 34, MICHIGAN • Phone: TWinbrook 3-7070

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BRIEFS

Institute Elects Officers

At its Spring meeting, the Fluid Controls Institute, Inc. elected new officers. President is Fred E. Weldon, General Controls, Skokie, Illinois. He succeeds James R. Lawler, Jr., Lawler Automatic Controls, Inc. Robert F. McCormick of Automatic Switch is 1st vice-president. Eric A. Bianchi of Worthington's Mason-Neilan Div. is 2nd vice-president. Paul K. Rogers, Jr., Skinner Electric Valve Div., is treasurer. Corporate secretary is Samuel J. Reid of Barnes & Jones, Inc.

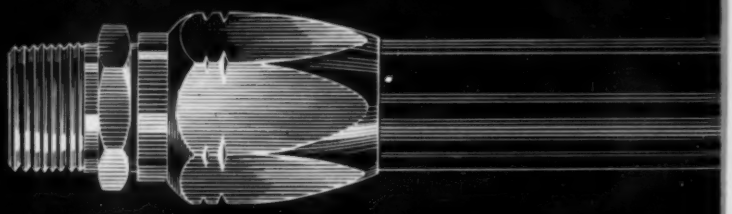
Product group meetings were devoted to development of voluntary standards to guide manufacturers and users of fluid-control products.

Members of the Institute include major manufacturers of automatic regulator valves, control valves, solenoid valves, and safety and relief valves. The address is P. O. Box 667, Pompano Beach, Florida. E. R. Rath is executive secretary. The Fall meeting will be at the Drake Hotel in Chicago, November 20-22. ▼▼▼

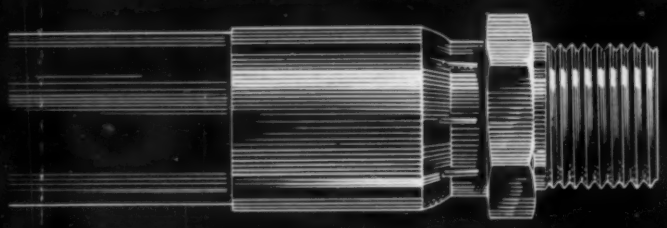
More Briefs on page 40

O.K., so you've got a 3000-gpm pump.

Circle **51** ➔

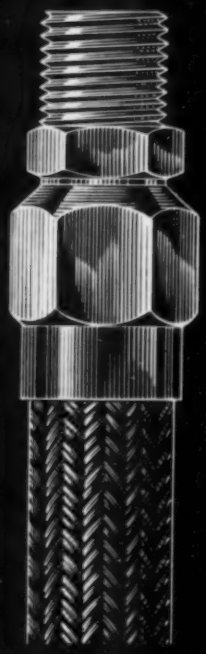


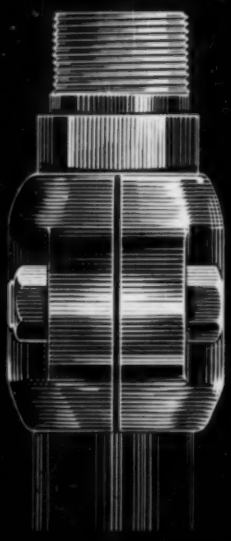
Eastman



YOUR
FLUID
POWER
LINE
HEADQUARTERS

BOOTH No. 161-2





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- Automotive
- Diesel Power
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- Railroads
- Industrial Lifts
- Trucking
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- Mining
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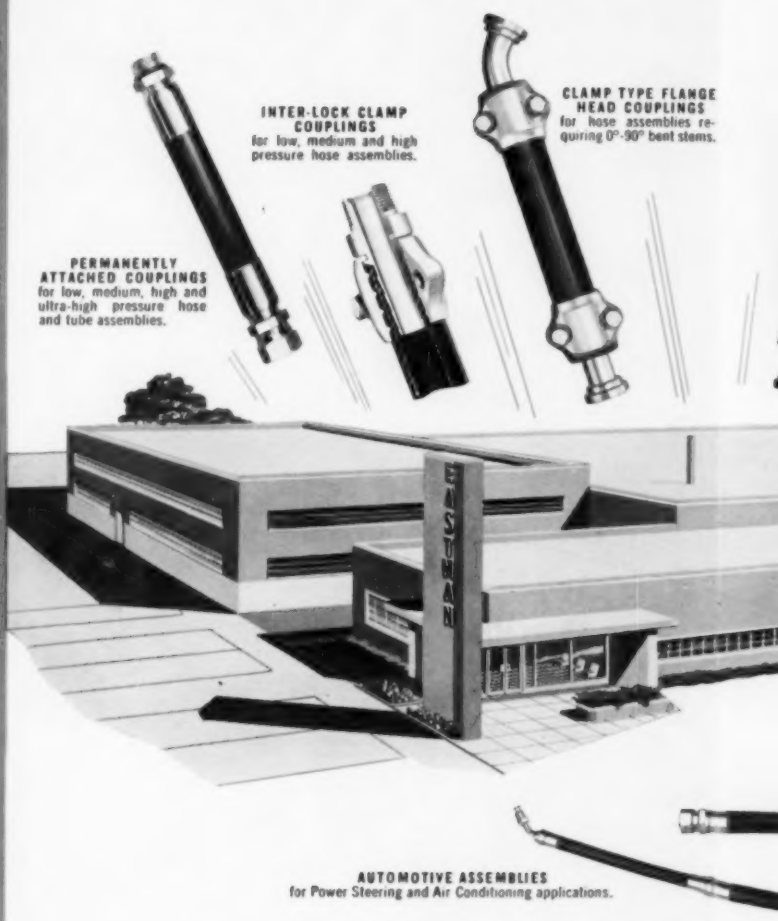
- Packaging
- Municipal Sanitation

Safeguarding America's Li


INTER-LOCK CLAMP COUPLINGS
for low, medium and high pressure hose assemblies.
CLAMP TYPE FLANGE HEAD COUPLINGS
for hose assemblies requiring 0°-90° bent stems.
PERMANENTLY ATTACHED COUPLINGS
for low, medium, high and ultra-high pressure hose and tube assemblies.
AUTOMOTIVE ASSEMBLIES
for Power Steering and Air Conditioning applications.

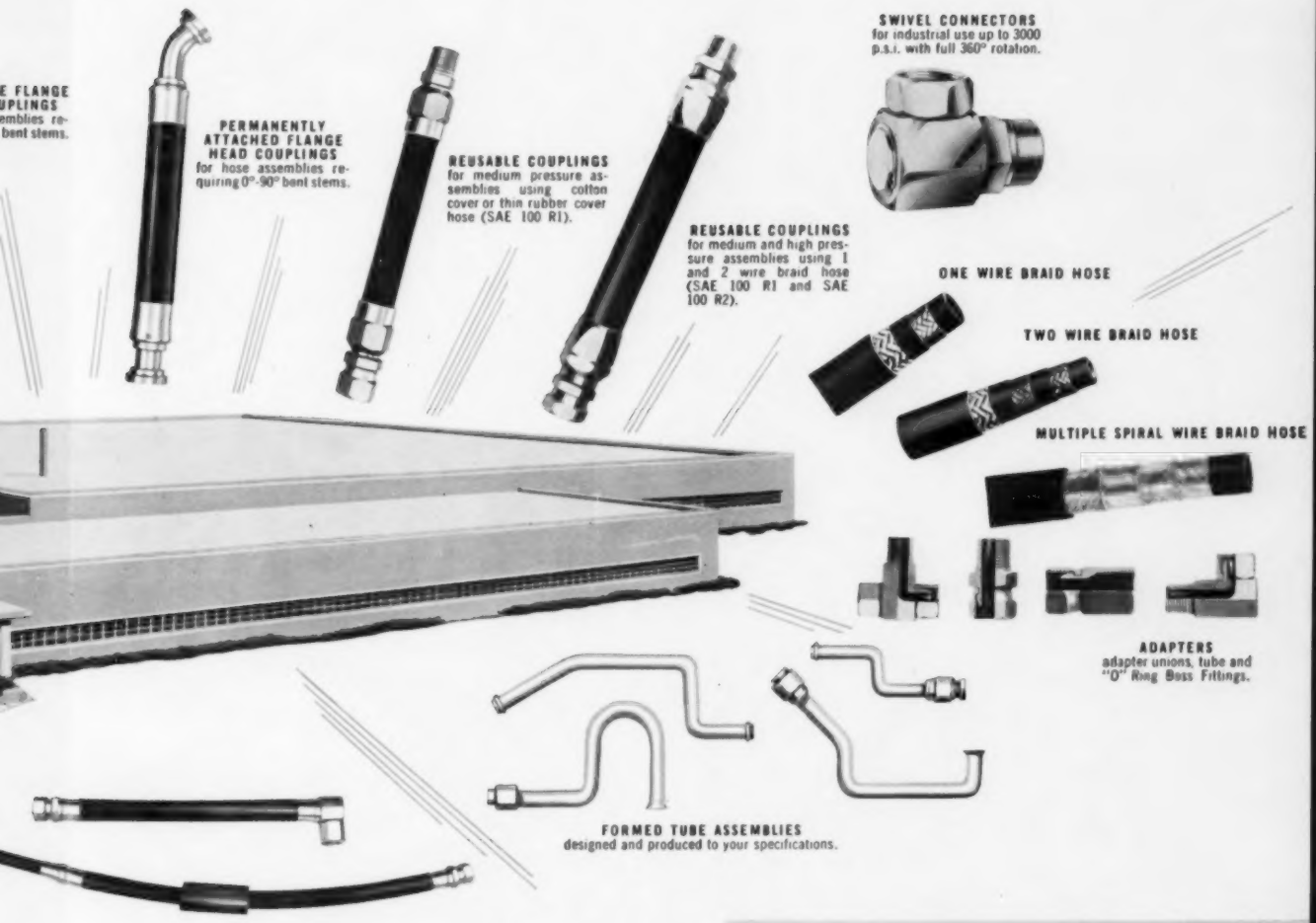
Many pioneer original equipment manufacturers have availed themselves of EASTMAN'S unequaled experience in Mobile Power Delivery in the past 30 years.

This rich backlog of experience—in converting many original mechanical power transmission systems to hydraulics—has helped EASTMAN to maintain its continued leadership in the development of *new hydraulic applications.*

EASTMAN has always accepted its responsibility of leadership as a challenge to the continued improvement of hydraulic power transmission. The popular EASTMAN Hydraulic Hose Assemblies shown here are working examples of improved coupling design and hose attachment . . . with many *exclusive features.*

Eastman MANUFACTURING CO., MANIT

...ca's Lifeline of Mobile Power for over 30 Years


...E FLANGE
...UPLINGS
...emblies re-
...bent stems.
PERMANENTLY ATTACHED FLANGE HEAD COUPLINGS
for hose assemblies requiring 0°-90° bent stems.
REUSABLE COUPLINGS
for medium pressure assemblies using cotton cover or thin rubber cover hose (SAE 100 R1).
REUSABLE COUPLINGS
for medium and high pressure assemblies using 1 and 2 wire braid hose (SAE 100 R1 and SAE 100 R2).
SWIVEL CONNECTORS
for industrial use up to 3000 p.s.i. with full 360° rotation.
ONE WIRE BRAID HOSE
TWO WIRE BRAID HOSE
MULTIPLE SPIRAL WIRE BRAID HOSE
ADAPTERS
adapter unions, tube and "O" Ring Boss Fittings.
FORMED TUBE ASSEMBLIES
designed and produced to your specifications.

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First in the field . . . first in engineering counsel . . . EASTMAN'S cooperative engineering counsel and service is highly respected and often requested by leading original equipment manufacturers. You are invited to join America's industrial leaders and consider their acceptance of EASTMAN'S high quality and performance as your finest recommendation—the "Standard of the Industry"!

Look to EASTMAN for consistent high quality and performance. Improve the sales appearance of your product as well as your competitive position in your field. It is not only a competitive advantage to be EASTMAN equipped, but a mark of distinction as well!

MANITOWOC, WISCONSIN

See Us at the SAE Convention

MAKE EASTMAN YOUR HEADQUARTERS

See how EASTMAN plans the original hydraulic systems on manufacturers' pilot models, shown in color slide films taken at manufacturers' development centers. See internal construction features of EASTMAN Hydraulic Hose Assemblies and Fittings on display at

BOOTH NO. 161-162

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SAE GUID

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Aeroquip Corp.	112-113
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DISPLAY HOURS

Mon.	10:00 a.m. to 6:00 p.m.
Tues.	10:00 a.m. to 5:00 p.m.
	7:00 p.m. to 9:00 p.m.
Wed.	10:00 a.m. to 6:00 p.m.
Thurs.	9:00 a.m. to 2:00 p.m.

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NATIONAL FARM, CONSTR

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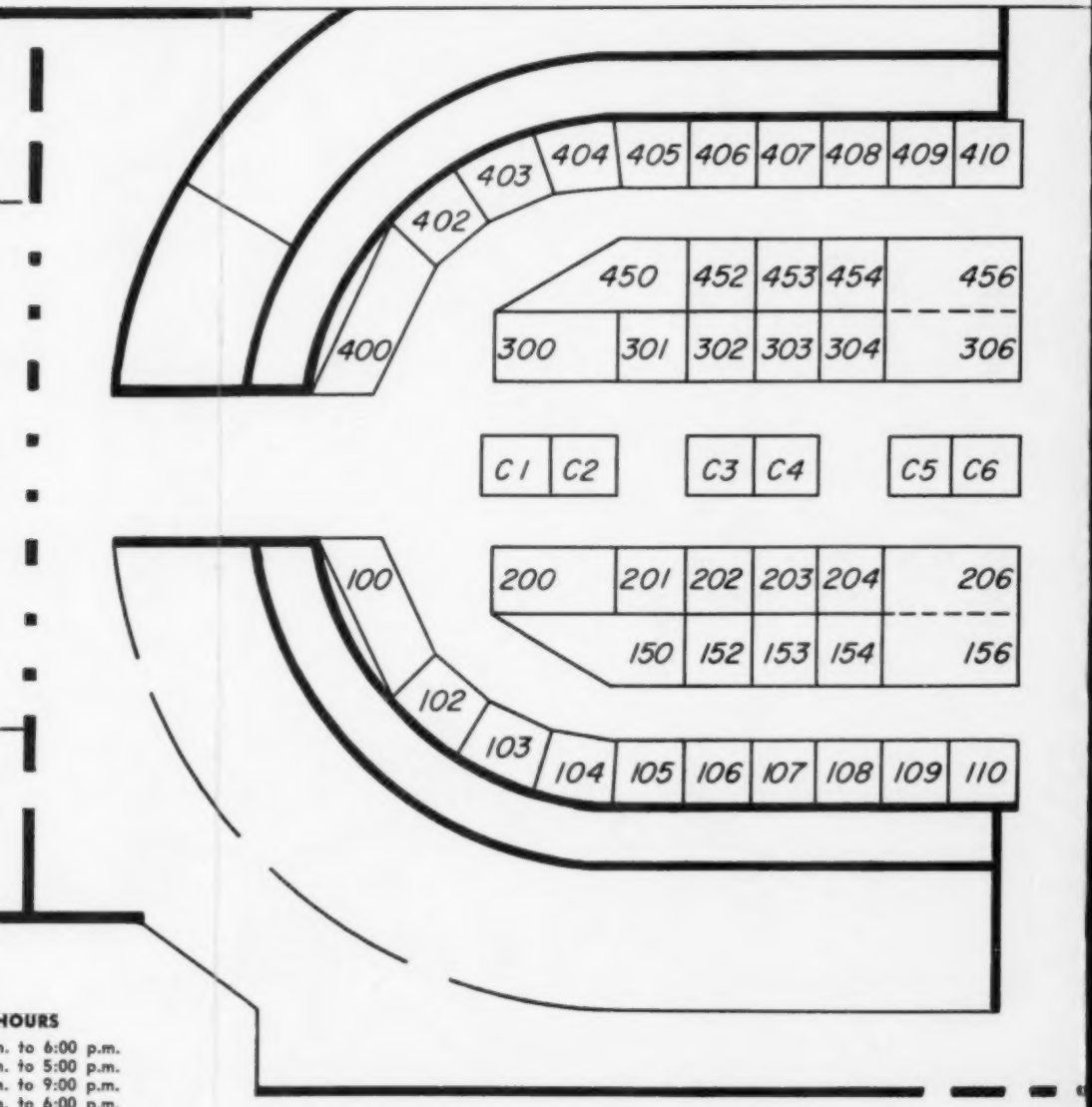

HOURS

. to 6:00 p.m.
. to 5:00 p.m.
. to 9:00 p.m.
. to 6:00 p.m.
. to 2:00 p.m.

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NATIONAL FARM, CONSTRUCTION, & INDUS

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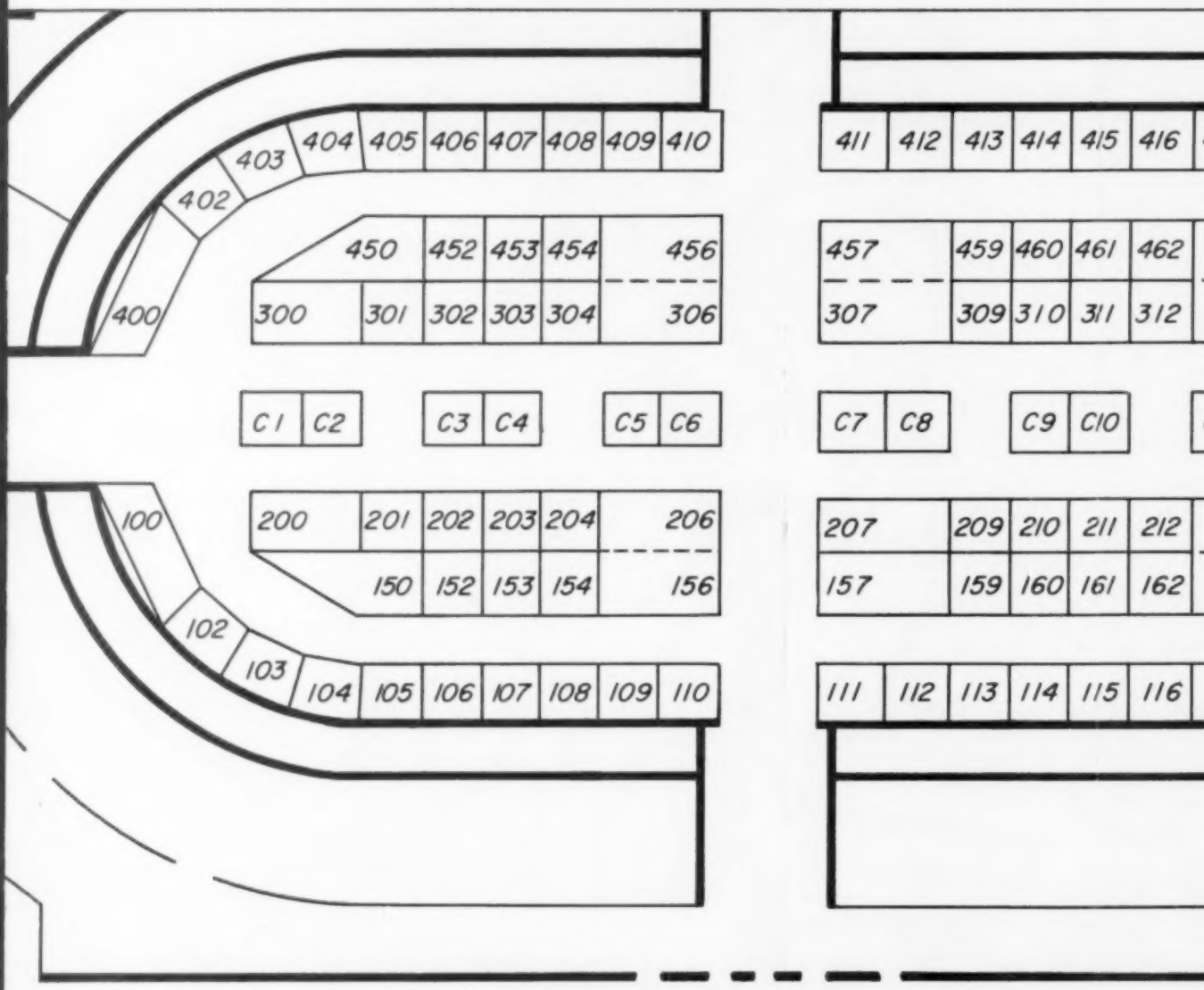
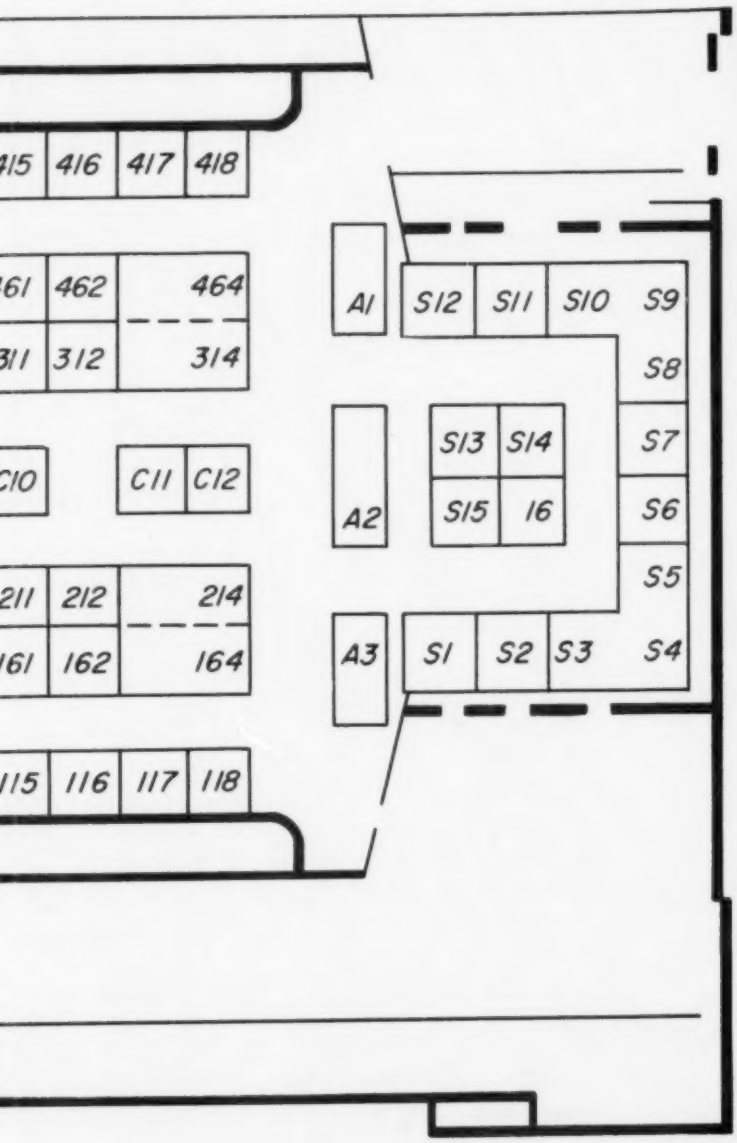


YOUR HYDRAULICS H

NDUSTRIAL MACHINERY SHOW

TORIUM, MILWAUKEE, WISCONSIN



PROGRAM

PRODUCTION FORUM

MONDAY
9:00 a.m.
- Heat-Treatment
- Engineering-Manufacturing Relationships
- Unique Manufacturing Processes

2:00 p.m.
- Welding Methods and Process Control
- Production Control Tools for Scheduling and Shop Loading
- Gear and Spline Design and Production

TUESDAY
9:00 a.m.
- Operating Experience with Numerically Controlled Machines
- Precision Tooling for Job Shop Operation
- Production Problems of Small Engines

TECHNICAL SESSIONS

TUESDAY
9:00 a.m.
- Skin for Earthmovers
- Air Cleaner Efficiency
- Lubricant Additives

2:00 p.m.
- Direction Determination
- Design Analysis and Component Life Investigation

WEDNESDAY
9:00 a.m.
- Steel Properties
- "Case Crushing"
- Fuel Additives

2:00 p.m.
- Air-Cooled vs. Water-Cooled Diesel Engines
- Hydraulic Filters

THURSDAY
9:00 a.m.
- Boom Design
- Clutches and Brakes
- New Tractors

2:00 p.m.
- Styling
- Power Train Bearing Life
- Elastomeric Vulcanizers

SPECIAL FEATURES

TUESDAY
Mid-morning
- Tractor Show

1:30 p.m.
- Plant Tour

WEDNESDAY
12:00 Noon
- Luncheon

FRIDAY
7:30 a.m.
- Golf Party

ALL WEEK
- Engineering Display

S HEADQUARTERS

BOOTH No. 161-162

SEE ADVERTISEMENT ON REVERSE SIDE

NATIONAL OIL SEAL LOGBOOK

Presenting!

NATIONAL BUD UNITIZED

TRADE MARK

National BUD UNITIZED has integral wear ring presenting rubber surface to shaft. Wear ring turns with shaft, sealing lip is never exposed to damage, cannot score shaft.

A new unitized oil-seal-and-wear ring that eliminates:

SHAFT WEAR OR SCORING

SEPARATE METAL WEAR SLEEVES

EXPENSIVE SHAFT FINISHES

COSTLY SHAFT RE-MACHINING

SEALING LIP INSTALLATION DAMAGE

SPECIAL INSTALLATION PROCEDURES

New National BUD UNITIZED seals are now in production, in a limited range of sizes, for heavy oil and grease sealing applications — including truck, bus and tractor uses. Still newer BUD UNITIZED seals are on the way for higher speed automotive and similar uses.

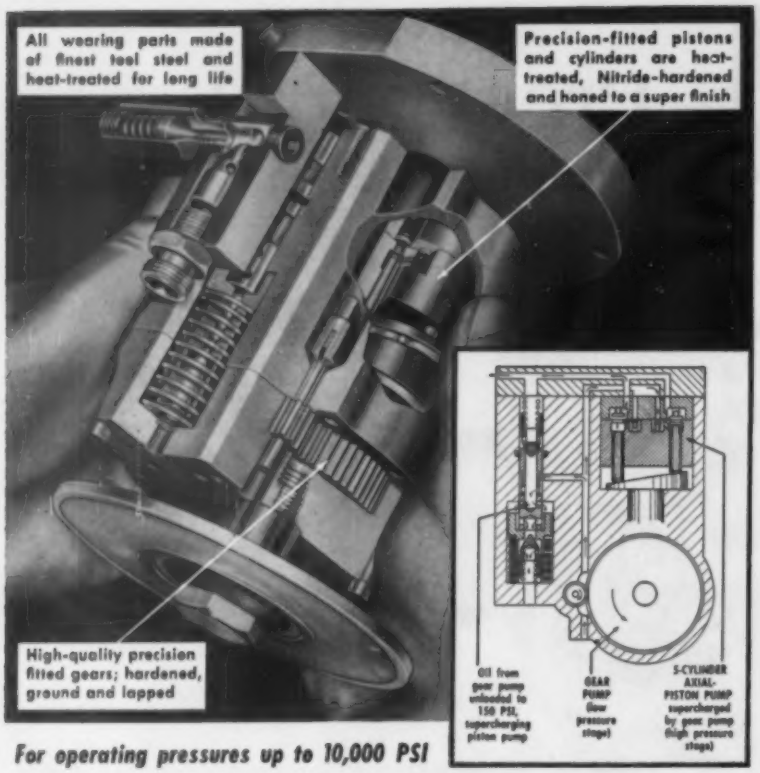
Changing a National BUD UNITIZED oil seal automatically changes the wear sleeve — in one fast, simple operation. Since the seal has its own integral wear ring, it is almost impossible to install it other than squarely on the shaft. Expensive shaft finishing is no longer a necessity, nor is leakage under a metal wear ring a problem — both thanks to the rubber surface BUD UNITIZED presents to the shaft.

For complete details or skilled engineering help on application of BUD UNITIZED seals, write direct, or call your National Seal Applications Engineer. You'll find him in the Yellow Pages, under Oil Seals.

NATIONAL SEAL

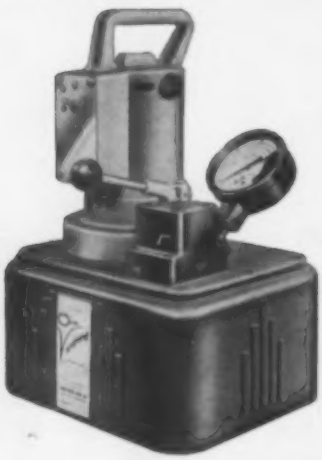
Division, Federal-Mogul-Bower Bearings, Inc.
General Offices: Redwood City, California
Plants: Van Wert, Ohio, Redwood City and Downey, California

6013-R


All wearing parts made of finest tool steel and heat-treated for long life
Precision-fitted pistons and cylinders are heat-treated, Nitride-hardened and honed to a super finish
High-quality precision fitted gears; hardened, ground and lapped
Oil from gear pump unloaded to 150 PSI, supercharging piston pump
GEAR PUMP (low pressure stage)
5-CYLINDER AXIAL-PISTON PUMP supercharged by gear pump (high pressure stage)

For operating pressures up to 10,000 PSI

New, unique 2-stage hi-pressure hydraulic pumping unit—dual-volume, dual-pressure

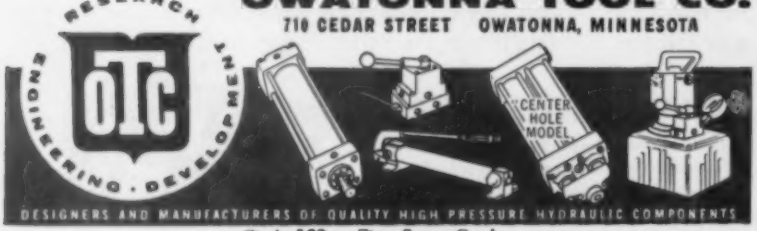


- **DELIVERS HIGH-VOLUME AT LOW PRESSURE**
- **2.6 GPM @ 100 PSI**
  1.75 GPM @ 500 PSI
  80 CU. IN./MIN. @ 1,000 PSI
  50 CU. IN./MIN. @ 10,000 PSI

The new and modern OTC "Vanguard" hi-lo hydraulic power package is a precision-built, high-quality unit meticulously crafted for dependable performance and long life. To best utilize the "Vanguard's" exceptional performance, a wide range of accessories are available: your choice of several motors, gasoline engine, 2 and 4-way lever-control valves, 2-way solenoid valve, pressure switch, pressure regulating valve, manifold, reservoirs, gauges, etc.

For detailed information on this advanced, new unit, write:

PRECISION HYDRAULICS DIVISION
OWATONNA TOOL CO.
710 CEDAR STREET OWATONNA, MINNESOTA



Circle **103** on Time-Saver Card

BRIEFS

NCIH Plans Completed

CHICAGO—Plans are now complete for the 16th Annual Meeting of the National Conference on Industrial Hydraulics to be held at the Sherman Hotel, Chicago, on October 20 & 21.

THIS 2000-LB FOOTLIFT TRUCK has fixed forks for low-underclearance pallets and skids. It can be equipped with forks for 48" load lengths. Its interchangeable hydraulic jack is sealed to prevent tampering. Hose lines and couplings are not needed. All packings have spring-actuated followers to compensate for wear. A by-pass valve at the top of the stroke prevents excessive strain, and eliminates air which may be trapped in the oil. The ball valves are self-cleaning. Manufacturer is Lewis-Shepard Products, Inc., Watertown, Mass.

Scheduled for presentation on October 20, are two papers on mobile equipment. "Steering by Hydrostatics" will be given by Charles Treadwell and Fred Williams of International Harvester Company. D. E. Rohweder of Caterpillar Tractor Co., will discuss "Hydraulic Control System for the D-8 Tractor Planetary Transmission". At the Materials Forming Machinery meeting, "Extrusion Presses" will be the subject of A. J. Matteo's paper.

On October 21, the Aircraft session will hear "The Reliability Concept and its Application in System Design" by Arthur Moskowitz, of North American Aviation. L. L. Hill and R. C. Flom, of Minneapolis-Honeywell Regulator Co., will talk about "Design

Continued on page 42

IT'S ICE-SLICK

Won't Stick at 30° Below

Try C/R K-400 Cups for Smoother Power Cycles

Any time you face the problem of reducing cylinder cup breakaway or sliding friction, chattering or freezing, come see us. We're reasonably certain that Chicago Rawhide's Sirvis Leather K-400 cups can help you. Their specialty is easy sliding — particularly in vacuum cylinders at sub-zero temperatures and in pneumatic cylinders at ambient temperatures and low pressures. Tests show a 50% reduction in breakaway and sliding friction over standard leather cups at ambient temperatures . . . and these K-400 cups are functioning beautifully in applications at -30° F. In another test, C/R Sirvis K-400 cups were run well over one million cycles at 20" of vacuum with negligible leakage and wear.

So if you are trying to design a new, smooth-working, low-friction pneumatic cylinder — or take the bugs out of an old one — jot down C/R K-400 cups and call us.

CHICAGO RAWHIDE MANUFACTURING COMPANY

SIRVIS DIVISION, 1203 ELSTON AVENUE • CHICAGO 22, ILLINOIS

Offices in 55 principal cities. See your telephone book.

In Canada: Chicago Rawhide Mfg. Co. of Canada, Ltd., Brantford, Ontario

Export Sales: Geon International Corp., Great Neck, New York

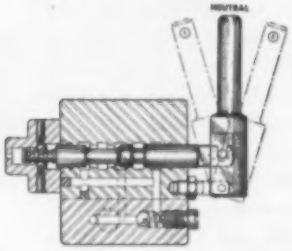
C/R PRODUCTS: C/R Shaft & End Face Seals • Sirvene (synthetic rubber) molded pliable parts • C/R Non-metallic gears

C/R

new 10,000 psi FOUR-WAY VALVES

effortless operation for applications up to 10,000 psi

Have valving problems on hydraulic applications calling for high pressures up to 10,000 psi? This new GREENLEE Four-Way Valve may be your answer. Simple, trouble-free spool-type valve . . . completely balanced to provide effortless operation at any pressure in any position. It operates with the same ease at 10,000 psi as at 0 psi. Panel mounted for universal adaptability. Subplate available. Precision-made, precision-tested. (Max. leakage 4 cu. in. per minute at 10,000 psi.) Write today for illustrated data sheet.



GREENLEE Four-Way Valve is available in two models: No. 1717 (above) with detent-positioned control lever . . . No. 1704 with spring-centered control lever.

THE GREENLEE LINE ALSO INCLUDES A WIDE SELECTION OF HAND AND POWER-OPERATED HYDRAULIC PUMPS

GREENLEE

GREENLEE TOOL CO.
1776 Columbia Ave., Rockford, Illinois

Circle 63 on Time-Saver Card

BRIEFS

Analysis of a two-Axis Electrohydraulic Tracer System". The Pneumatics session has scheduled G. Riske of Parker-Hannifin Corp. to discuss "Clean System Design by Proper Sizing".

H. M. Clark, Manager of Engineering Hydraulic Products, Thompson Ramo Wooldridge, Inc., will speak on "The Slipper-Type Pump for Automotive Hydraulics."

Awards will be presented to the winners of the 1960 HYDRAULICS & PNEUMATICS Fluid Power Prize Paper Contest. Additional information may be obtained from Conference Secretary William Smith, Illinois Institute of Technology, Chicago 16.

More Briefs on page 44

BRIEF NOTES

TENTH AIRCRAFT HYDRAULIC CONFERENCE . . . will be held by Vickers, Inc. at the Pick Fort Shelby Hotel, Detroit, on Nov. 2, 3 & 4. On the agenda: comprehensive appraisal of jet age service problems, and applications of Fluid power to jets, missiles, and space vehicles. Attendance is by invitation.

BROOKS INSTRUMENT CO. INC. . . . is the new name of Brooks Rotameter Co., manufacturer of flow measurement meters.

VITON IN SEALS & GASKETS . . . is covered in one of the Technical Notes series of Stillman Rubber Co., Culver City, Calif. The literature gives Viton's temperature ranges, physical properties, and chemical resistance. It discusses copolymers and elastomers in which Viton is used, and general applications.

NEW MOLDING COMPOSITION . . . based on Du Pont's Teflon 100 will be produced by Crane Packing Co. Primarily adaptable for injection molding, this new molding powder will retain Teflon 100 FEP properties but at greatly reduced fabricating costs.

HYDRAULIC PISTON ACCUMULATORS . . . are being made by a new company, Hydrodyne Industries, Inc., Westbury, L. I., N. Y. Capacities are from 10 cu. in. to 23 gal. The accumulators are for pressures to 10,000 psi, and temperatures to 400 F.

BUSINESS BRIEFS

MERGER OF IMPERIAL BRASS AND EASTMAN MFG. CO. . . . was announced jointly by the two companies. Imperial Brass manufactures flared tube fittings, compression fittings and tube forming tools. Eastman makes high pressure hydraulic assemblies for rigid and flexible hydraulic power lines.

LONG RANGE R & D EXPANSION PROGRAM . . . is underway at Rochester Manufacturing Co. makers of liquid level temperature and pressure gages. President Hastings said that 1959 was the best year in the firm's history.

AMERICAN BRAKE SHOE BUYS FRENCH PLANT . . . through its Swiss subsidiary, Brakeshoe International, S. A. The industrial hydraulic equipment plant bought from La Precision Moderne is in Vierzon, 100 miles south of Paris.

AUTOMATED MASS PRODUCTION . . . has cut the price of shut-off valves by 50% according to Hydromatics, Inc., Livingston, New Jersey. Rated at 3000 psi, the stainless steel or brass valves have interchangeable or replaceable NPT or tube end fittings.

HYDRAULIC RESEARCH & MFG. CO. . . . of Burbank, Calif., has been acquired by Textron Inc. The servovalve manufacturer was part of Bell Aircraft's defense group purchased by Textron.

for a quality product

use a quality "O" ring

be safe with PRECISION!

Precision "O" Rings are engineered specifically for your product! They're made to do the job better... longer. They meet all military and commercial specifications. Precision "O" Ring quality is maintained by over 100 inspections and quality control tests. There's a size and compound to meet YOUR requirements. If it's Precision – it's Precision-made! Write, wire, or phone for data sheets or help of a Precision Sales Engineer today.

Precision Rubber Products Corporation

"O" Ring and Dyna-seal Specialists

Dept. 1, Oakridge Drive, Dayton 17, Ohio **Canadian plant at: Ste. Thérèse de Blainville, Québec**

FOR MOBILE EQUIPMENT
FOR MATERIALS HANDLING SYSTEMS
FOR MISSILES, ROCKET LAUNCHERS AND AIRCRAFT
RACINE
HYDRAULIC COMPONENTS
The heart of BETTER MACHINERY
Racine hydraulic pumps, valves, controls and pressure boosters are available for application in practically every hydraulically operated circuit . . . be it in use or in the design stage . . . whether on equipment being manufactured or equipment used in manufacturing. For the most versatile, the most stout-hearted hydraulic components, RACINE is a popular choice with industry everywhere.
FOR METALWORKING MACHINERY AND TRANSFER EQUIPMENT
FOR FARM EQUIPMENT
FOR PRINTING, PAPER PROCESSING, WOODWORKING AND OTHER SPECIAL INDUSTRY MACHINES
FOR RAILROAD EQUIPMENT
RACINE
Racine Hydraulics & Machinery, Inc.
RACINE, WISCONSIN
HYDRAULICS DIVISION
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BRIEFS

Europeans Discuss Standards

Delegations from the hydraulic industries of Germany, Holland, Switzerland, France, Belgium, Sweden, and the United Kingdom met at the European International Oil Hydraulic Commission Conference in London, May 27th. Hosts were the Hydraulic Association of Great Britain and the Association of Hydraulic Equipment Manufacturers. The latter group's president, J. Johnstone, welcomed the delegates. He spoke of the importance of the work on international standards done by the Technical Committee. The rapid expansion of hydraulics demands international standards of dimensions, materials, symbols, and terminology, he said. Conference chairman V. Pomper of Paris referred to the work that had been done to coordinate the various national standards, to submit proposals to the International Standards Organization in Geneva. The proposed standards have been accepted in Germany, by the French machine tool industry, and by the major French car manufacturers.

The French delegation was assigned to complete the work on thread standardization. The Swedish delegation was asked to complete a report on use, service, and

CHRYSLER ENGINEER TED WAHL (right) receives 1st prize trophy from E. E. Smith, J. N. Fauver Co. in Hunt Valve Company's contest at the ASTME show. Wahl replaced a Hunt valve in the fastest time of 14.95 seconds.

maintenance of hydraulic equipment and systems. The Belgians were invited to submit proposals on the conditions governing guarantee and delivery of hydraulic components. M. Pomper requested that these tasks be completed by the next meeting, in Frankfurt, Germany, in November.

Discussing membership, the group decided that if a country has its own national organization to represent its hydraulic industry, and if the body is free from political pressure or affiliations, then its application would be considered on its own merits.

Mr. Levetus, chairman of the (British) Association of Hydraulic Equipment Manufacturers, said that all standards and symbols should be examined by the technical committees of each national organization, so that recommendations should be compatible with the technological side of the industry. ▼▼▼

Big Fork Truck Handles 35 Tons

The biggest general-purpose fork truck ever built has been introduced by Clark Equipment Co.'s Industrial Truck Div. Hydraulics plays a big part. The Ranger 700 has power steering, power-shift transmission, and 4-wheel, power-assisted hydraulic brakes. Hydraulics moves the 3000-lb forks apart and together, to fit different load widths. The forks can be moved simultaneously left or right to pick up off-center loads. The two lift cylinders and the two tilt cylinders have 9½" bores.

The hydraulic system has four pumps: one each for the steering controls, the tilt-lift mechanism, the side-shifting device, and the torque converter. Combined capacity of the pumps is 150 gpm.

Because its massive loads would

Continued on next page

TRANSFER MACHINE BUILT BY BUHR MACHINE TOOL CO., ANN ARBOR, MICHIGAN

Automated GIANTS like this

REQUIRE STRONG HYDRAULIC *HEARTS* EVERY MINUTE OF THEIR WORKING LIFE

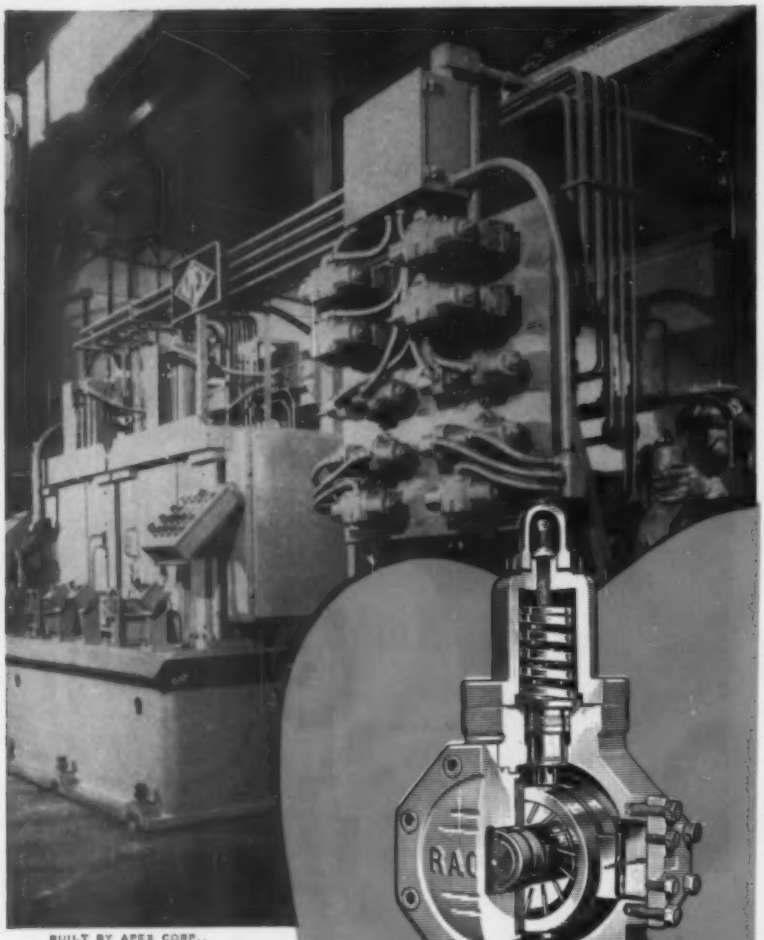
24 RACINE PUMPS *operate this 58 station 500-ton transfer machine*

The precisioned flow control of RACINE PUMPS assures the split-second timing and efficiency required to operate this complex Buhr Transfer Machine . . . custom-built for the completely automatic machining of 120 auto-cylinder heads hourly for a leading automotive manufacturer. Compact RACINE VALVES control feeds and reverse movements on all 323 operations performed by the machine. RACINE 4-WAY SOLENOIDS help one man operate this mechanical giant. Buhr has used RACINE PUMPS and Reservoir Units on custom-built machines for the automotive industry for over 10 years.

RACINE

Racine Hydraulics & Machinery, Inc.
RACINE, WISCONSIN
HYDRAULICS DIVISION

Circle **114** on Time-Saver Card



BUILT BY APEX CORP., ROSEVILLE, MICHIGAN

This active hydraulic heart helps

SEAL POROSITY IN 106 TRANSMISSION CASES EVERY HOUR

A RACINE VARIABLE VOLUME PUMP and 10 RACINE VALVES control *all* mechanical operations in this Apex impregnating machine, which seals leaky transmission cases at a major auto firm's transmission plant in Toledo, Ohio. Apex specified RACINE equipment because its design simplifies machine design problems . . . eliminates the need for extra pumps and valves. RACINE PUMPS are easy-to-control . . . handle pressure compensation *automatically* for varying gpm requirements. Apex has *preferred* RACINE for over 10 years!

the HEART of this impregnating machine is a RACINE MODEL 6FA PUMP

RACINE

Racine Hydraulics & Machinery, Inc.
RACINE, WISCONSIN
HYDRAULICS DIVISION
Circle 115 on Time-Saver Card

BRIEFS

often obstruct the operator's forward view, the truck has two sets of controls. After swiveling in the bucket seat, the operator can use the rear controls to drive in reverse with comfort and complete visibility.

The first five Rangers will handle steel slabs at temperatures to 2000F. Because of the heat, Clark built in special features, including fire-resistant fluid. ▼▼▼

Air System Speeds Lifting

Sprague Meter Co., Bridgeport, Conn. has mechanized a lifting operation on its gas-meter production line. Sprague spray-paints the meters just before inspection and crating.

Before the mechanization, the workman lifted the meter and hooked it to an overhead conveyor which carried it through the spray booth. The lifting tired the workman, and made it difficult to secure the units safely.

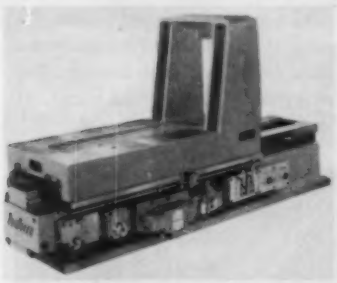
Sprague production men built a small elevator into the surface of the workbench. They connected it to a single-acting air cylinder mounted vertically beneath the bench. When the workman steps

on the pedal of a 3-way valve, the cylinder lifts the bench-top section smoothly and quietly. A flow-control valve between the valve and cylinder regulates rate of rise. The workman then hooks the meter to the conveyor line, and takes his foot off the pedal. The platform retracts, becoming part of the bench top, ready to receive the next meter. ▼▼▼

New Books

Guide to the Space Age, *by C. W. and Hazel Besserer,* 320 *pp,* $7.95, *Prentice-Hall, Inc.*

The book lists alphabetically and defines in layman's language over 5000 words and phrases of space technology, rocketry, and missilery. Complete cross-references, equations, diagrams, and drawings supplement the definitions. Included are basic technical terms directly related to the art, terms peculiar to the fields, standard abbreviations and acronyms, trade vernacular, and descriptions of missiles, rockets and space satellites, probes, and ships. The book was written to help standardize the specialized language. Its form gives both technical and non-technical people a quick source of clear, concise information. ▼▼▼

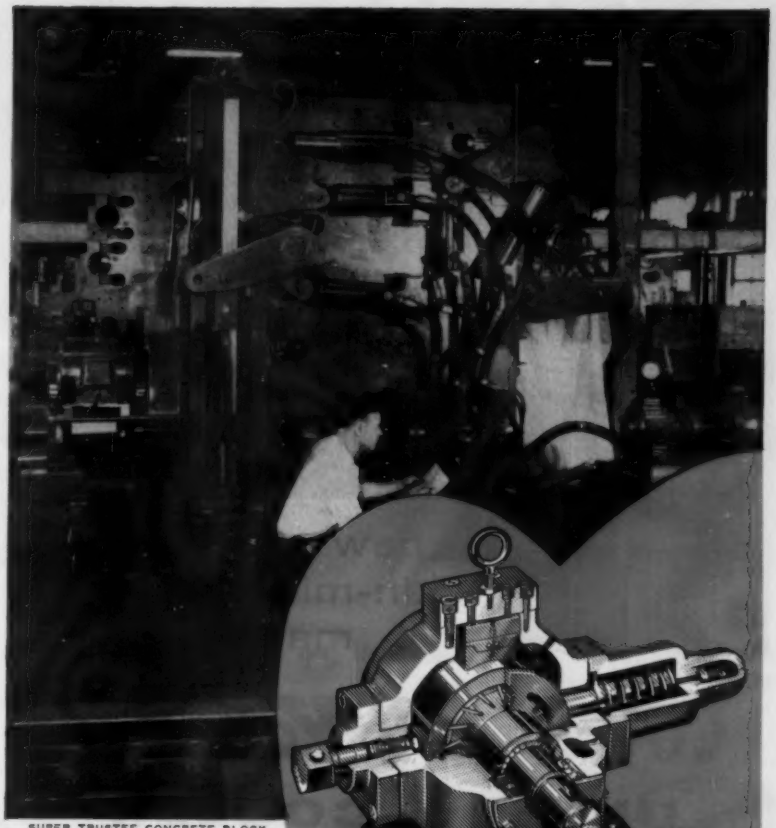


COMPACT HYDRAULIC INSTALLATION on this Buhr way unit requires only three lines from the tank. Unit has removable cartridge-type cylinders, and built-in check valves to eliminate surges. Hydraulic valve and manifold components are interchangeable among all unit sizes.

Hydraulics Speeds Compaction

An automatic, hydraulic, multi-compaction press produces tantulum capacitor anodes at a greatly increased rate. Former compaction methods required that the die cavity be hand-filled by the operator, who then positioned the wire lead with tweezers. Production time was 4 or 5 anodes a minute. There was considerable powder loss from spillage. This top-and-bottom ram press needs no operator. It produces 25 anodes/min.

Continued on next page



SUPER TRUSTEE CONCRETE BLOCK MACHINE BUILT BY THE GENE OLSEN CORP., ADRIAN, MICHIGAN

This dependable hydraulic heart

The heart of this 1100 blocks per hour concrete block machine is a RACINE MODEL 8R PUMP

REDUCES UPKEEP AND DOWN-TIME BY AS MUCH AS 80%

"RACINE HYDRAULIC EQUIPMENT is the *heart* of our concrete block machines," says C. S. DeLamater, sales manager for The Gene Olsen Corp., another satisfied user of RACINE PUMPS and VALVES exclusively since 1949. Besides the tremendous savings in operating hydraulically-designed concrete block machinery, the firm emphasizes the advantage of simplified control of oil circulation in RACINE VARIABLE VOLUME PUMPS. They pump *only* the oil required to do the job — no waste of pressure oil — no heating. Thus through lower horsepower, operation economies are enjoyed.

RACINE

Racine Hydraulics & Machinery, Inc.
RACINE, WISCONSIN
HYDRAULICS DIVISION

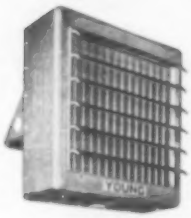
Circle **116** on Time-Saver Card

new automatic skin-milling machine

COOLED by Young

UNIT OIL COOLER

Metal coverings for modern supersonic aircraft and missiles are skin thin. Minute ripples must be removed to prevent turbulence in high speed flight. The above magnetic tape controlled milling machine accurately performs this task automatically. This efficient operation is cooled by an electronically controlled power package equipped with a Young OH-19 Unit Oil Cooler. The Young high-performance heat transfer unit serves the dual purpose of cooling oil and utilizing the "waste heat" to warm the interior of the building.



Patented Young Turbulator increases heat transfer 100%. Formed from a one-piece metal strip, the Young Turbulator breaks up fluid flow so that the fluid is constantly wiping tube surface for maximum heat transfer.

for efficient Oil-to-Air Cooling select Young Type "OH" Unit

OIL COOLERS

The cooling core of the Type "OH" Unit Oil Cooler is constructed of non-ferrous fins mechanically bonded to seamless tubes for maximum efficiency. Tubes are joined to steel headers by a special process which eliminates leaks and provides greater strength to the entire cooling element. Casings are of heavy gauge steel reinforced for strength and rigidity.

Write Dept. 440-J for Catalog No. 3560 Type "OH" Unit Oil Coolers

Specially practical for cooling lube oil where water is at a premium, and/or waste heat can be used to warm room interiors.

Young YOUNG RADIATOR COMPANY

General Offices: Racine, Wisconsin

Plants at: Racine, Wisconsin and Mattoon, Illinois

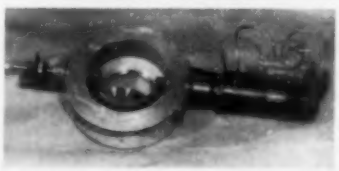
Circle **160** on Time-Saver Card

BRIEFS

Tantulum wire is fed from a spool at the top of the press. The wire goes through the hollow top ram, to the cut-off mechanism and the upper compacting punch. Tantulum powder is placed in the die cavity through a mechanically-actuated horn feed. The horn pushes the ejected compaction clear of the die cavity.

The top ram descends on the die cavity, compacts the powdered tantulum against the bottom ram and punch, and places the wire lead. The top ram then de-energizes, and the bottom ram ejects the completed compaction.

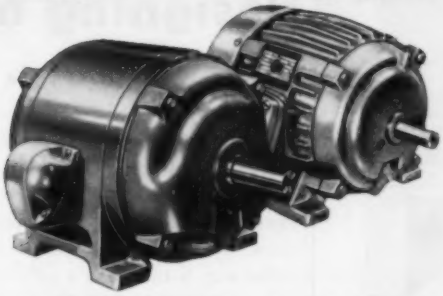
Ram pressures must have very close tolerances. This press holds lengths to .005″, and density variations to 1% of specification. A 3-hp, 1200-rpm electric motor drives a split-flow, vane pump. All hydraulic controls are on a manifold on the lower front of the press. Capacity is one ton. Manufacturer is Denison Engineering Division. ▼▼▼



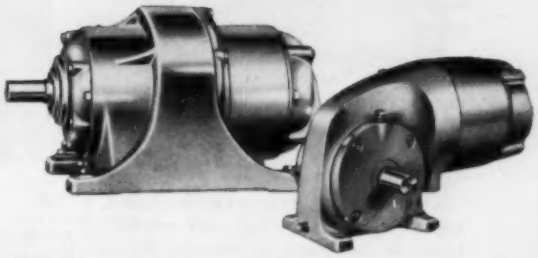
ROTARY ACTUATOR operates spherical valve which controls grain feed into a mash cooker. Pneumatic operating pressure is 40-50 psi. General Machine Co., Newark makes the unit.

Circle **141** →

Which U.S. MOTOR will solve your problem?

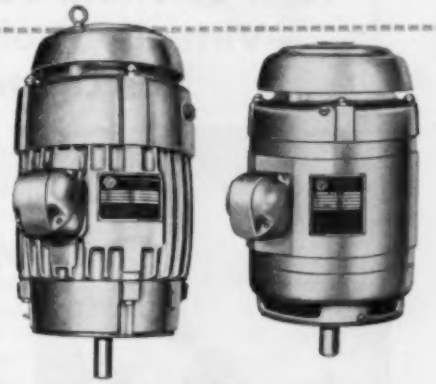


1 **HORIZONTAL MOTORS,** *Uniclosed,* dripproof, ½ to 250 h.p.; *Totally Enclosed,* 1 to 150 h.p.; *Explosion-Proof,* 1 to 150 h.p. (Other available types not shown)



2 **INTERNALLY GEARED MOTORS,** *Syncrogear,* ⅓ to 30 h.p.; *Syncrogear Right-Angle* worm-gear, ½ to 2 h.p. (Other available types not shown)

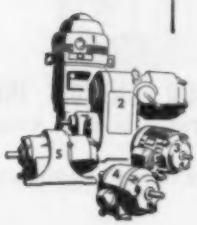
3 **VARIABLE SPEED MOTORS,** *Varidrive,* upright, ¼ to 75 h.p.; *Varidrive,* horizontal, ¼ to 60 h.p. (Other available types not shown)



4 **VERTICAL MOTORS,** *Unimount* vertical solid shaft, ½ to 500 h.p.; *Unimount Totally-Enclosed,* ½ to 150 h.p.; *Unimount Explosion-Proof,* ½ to 150 h.p. (Other available types not shown)

U.S. makes many types of motors...*for many uses in many industries*

There are U.S. MOTORS specialized to serve virtually all fields of industry. The above are just a few of them. Whatever your application, chances are that there's a standard U.S. MOTOR designed to fit it—for U.S. has been meeting specialized industrial needs for over half a century. The quality that is built into each U.S. MOTOR *at every point* is your assurance of long, trouble-free operation. U.S. offers, too, packaged systems of automatic speed control based on U.S. VARITROL or other automatic controls. U.S. VARIDYNE POWER PACK converts any standard AC fixed-speed motor to adjustable speeds. Besides motors and controls, U.S. furnishes power drives both for separate-mounted motors and for non-electrical applications. If you need motors...automatic controls...geared or belted drives...write or phone.



U.S. MAJOR MOTOR LINES INCLUDE:
1. Vertical Solid & Hollowshaft, 2. Varidrive, 3. Totally-Enclosed, 4. Uniclosed, 5. Syncrogear. Also, many other special motors.

U.S. ELECTRICAL MOTORS INC.

BOX 2058, LOS ANGELES 54, CALIFORNIA
OR MILFORD, CONNECTICUT

FREE COLOR-ILLUSTRATED BROCHURE...
For specific data write for General Bulletin.

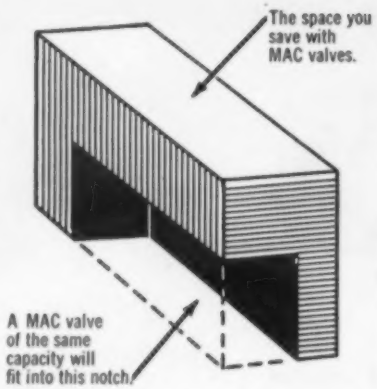
Cuts Air-Valve Size 67% with New Design

Also Boosts Performance, Life, and Ease of Service

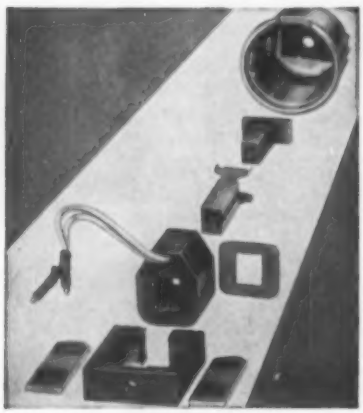
A remarkable new line of pilot-operated air-valves—the MAC series 300—cuts space requirements to ⅓ of that normally required for valves of equal capacity rating.

Not only is the valve extremely simple in operation, reducing cost, but the three moving parts can be replaced in a matter of 1 to 2 minutes without special tools. Life of moving parts is rated at 30,000,000 cycles, minimum.

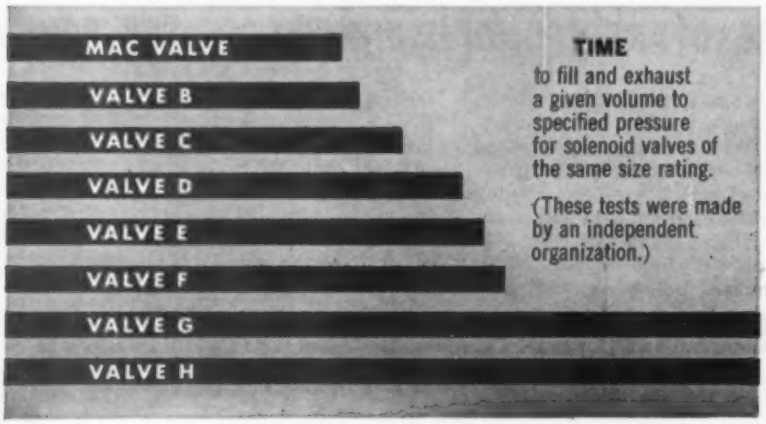
The story of how this was accomplished, together with valve sizes and specifications, is contained in Bulletin #300A available from Mechanical Air Controls on request.



New Solenoid Boosts Valve Life —Virtually Foolproof, it also has Lighter Draw



A virtually failure proof solenoid which can be completely assembled or taken apart without any tools—but which can't be assembled wrong has been developed by Mechanical Air Controls. It has no welds to break or crack. It has no screws, nuts, bolts or other fasteners to work loose. It has a fully encapsulated water and oil resistant coil. There is no wiring through air valve body. The connections just plug in. The entire assembly floats on rubber mounts, the rubber being in shear. The solenoid has a lower draw because of the lighter push required. The design provides for both locking and manual jogging. It is standard on every MAC series 300 air valve.



advances in
PNEUMATICS

MAC

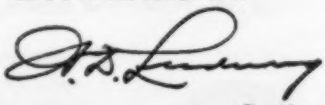
designing an air valve . . .

There are two ways to design air-valves. One is for a specific job, and no more. For example, a valve in a missile usually has to function only once. Wear life is no problem. The other way is to design a valve for the *toughest* job it might face and then use it on easier jobs, too.

Any engineer would prefer the second way, but he wonders "Won't it cost too much?"; or "Won't I be criticized for providing more performance or life than needed?"

His worries are pointless. The second way doesn't have to cost more. Extra performance and quality can be a free "plus." If you design air-valves for the TOUGHEST jobs they can encounter (as we did at MAC) you can naturally get a simpler, more compact, easier-to-service valve; plus extra performance reserve—all AT LOWER COST.

Why? Once the valve licked the toughest application—where speed, reliability, serviceability and life were MOST vital—we simply standardized for mass production. That's how we wound up with a better and lower cost valve . . . the series 300.



President

MAC

MECHANICAL AIR CONTROLS, INC.
10030 Capital, Oak Park • Detroit 37, Michigan

FUTURE EVENTS

MACHINE TOOL EXPOSITION & MEETING
September 6-16
International Amphitheatre
Chicago, Illinois

PRODUCTION ENGINEERING SHOW
September 6-16
Navy Pier
Chicago, Illinois

ASME JOINT AUTOMATIC CONTROL CONFERENCE
September 7-9
Massachusetts Institute of Technology
Cambridge, Mass.

2ND COLISEUM MACHINERY SHOW
September 7-15
Chicago Coliseum

ASME RUBBER & PLASTICS CONFERENCE
October 9-12
Lawrence Hotel
Erie, Pa.

SAE COMMITTEE A-6 MEETING
(Aero-Space Hydraulic & Pneumatic Systems & Equipment)
Week of October 17
Whitcomb Motor Hotel
San Francsico, Calif.

ASME-ASLE LUBRICATION CONFERENCE
October 17-19
Statler Hilton Hotel
Boston, Mass.

FLUID POWER SOCIETY ANNUAL MEETING
October 19
Sherman Hotel, Chicago
For additional information write Barrett Rogers, 5595 N. Hollywood Ave., Milwaukee, Wisc.

16TH NATIONAL CONFERENCE ON INDUSTRIAL HYDRAULICS
October 20-21
Sherman Hotel
Chicago, Illinois
For additional information, contact William Smith, Illinois Institute of Technology, Chicago 16, Illinois

NATIONAL FLUID POWER ASSOCIATION FALL MEETING
October 31-November 2
Edgewater Beach Hotel
Chicago, Illinois

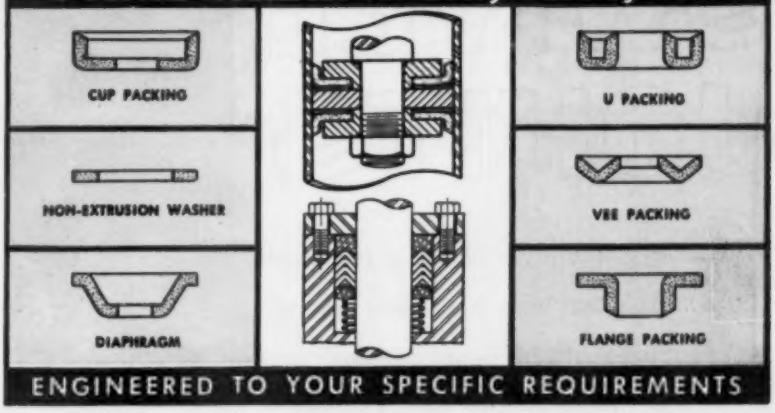
ASTME WESTERN TOOL SHOW
November 14-18
Los Angeles Memorial Sports Arena

MARSH *Thermo* LEATHER PACKINGS

IMPREGNATED WITH SYNTHETICS!

616:

312:



616: Has a synthetic rubber impregnated into thermo leather. Temperature will not take out this rugged treatment. At the same time it stays flexible at low temperatures of —65° without becoming hard or brittle. 616 is very resilient, springy and tough . . . resists abrasion. Used for oils, new synthetic fluids, aircraft oils, air service and resists solvents.
Makes very fine cups, vees, "U" packings, flange packings and non-extrusion back-up washers.

312: Has a synthetic impregnated into the thermo leather, one of the first developed by Marsh. It is the accepted standard in many hydraulic and pneumatic installations. Its temperature range is satisfactory for most standard applications. This utility treatment makes fine cups, flange packings and "U" packings. It is a resilient but firm packing. Used for air, oil and water service.

Sample packings to your production requirements will be made up if you will let us know your needs.

WRITE FOR OUR NEW BROCHURE ON OUR 612 BACK-UP WASHERS MADE OF THE THERMO-SYNTHETIC RUBBER COMBINATION.

C·W·MARSH COMPANY

MAIN OFFICE AND FACTORY: MUSKEGON, MICHIGAN

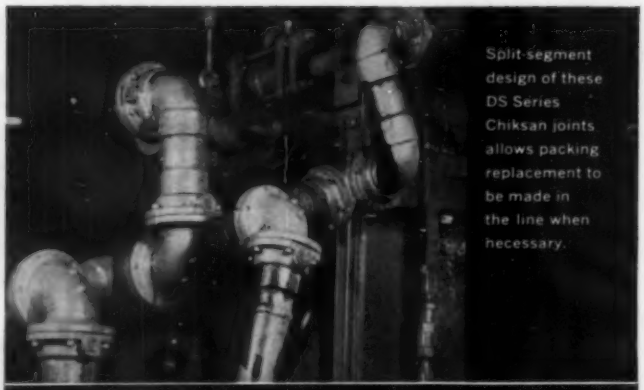
SALES OFFICES: 3756 W. Dexon Ave. Chicago 45, Ill. · 101 Park Ave. New York 17, N. Y. · 1900 Euclid Ave. Cleveland 15, Ohio · 2119 S. Atlantic Blvd Los Angeles 22, Cal.

Circle **89** on Time-Saver Card

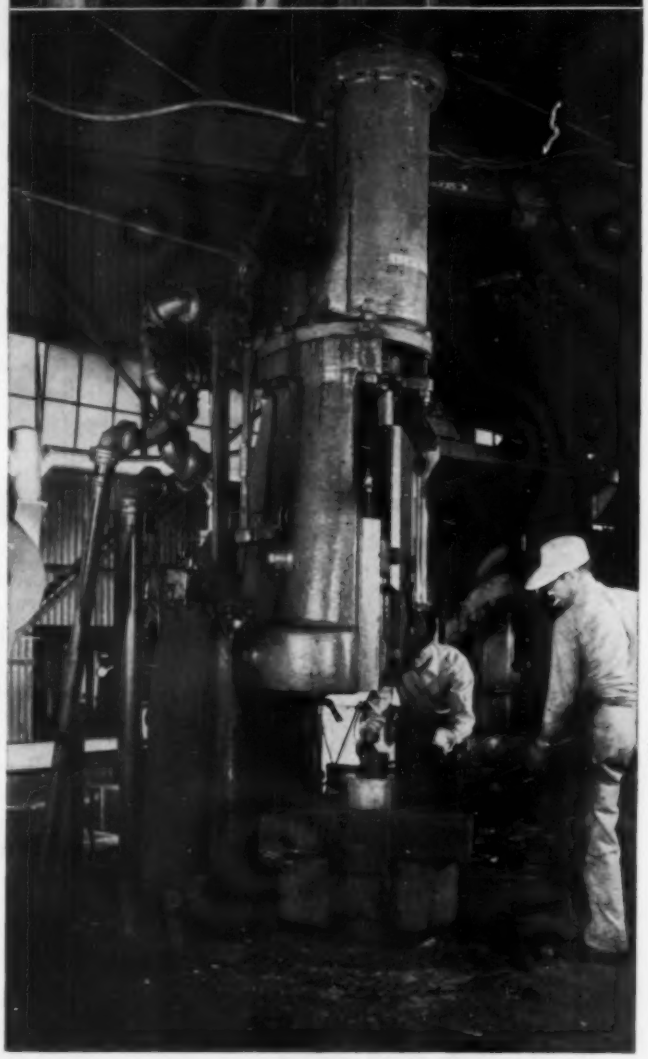
DESIGN SAFE, DURABLE FLEXIBILITY INTO YOUR LINES with CHIKSAN SWIVEL JOINTS

Whenever you apply Chiksan swivel joints, you get a line that lasts longer and reduces maintenance costs for years to come. Flexing in predetermined arcs, Chiksan joints eliminate common causes of line failure due to tight bends or torsional fatigue. Wherever certain designs require wide hose loops, Chiksan joints permit shorter, more compact lines. In fact, wherever fluid or air lines require flexibility, Chiksan swivel joints can provide a direct and lasting benefit.

Chiksan joints are available from stock in a wide range of materials, temperatures and pressures, to meet practically every design requirement. Write Chiksan Company, Brea, California, today for a catalog and the name of the representative in your area.



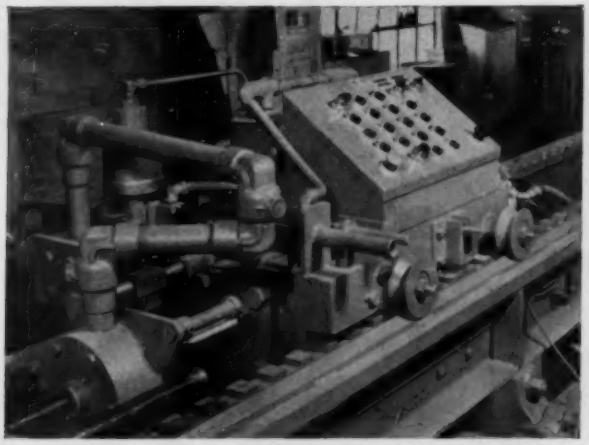
Split-segment design of these DS Series Chiksan joints allows packing replacement to be made in the line when necessary.



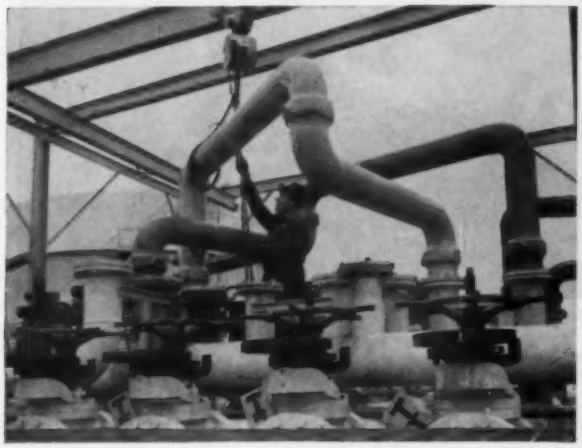
SHOCK, HIGH PRESSURE STEAM DOESN'T FAZE THESE CHIKSAN JOINTS—A 2000 pound dropforge with high pressure steam sets up a rough set of service conditions. These Chiksan swivel joints replaced flexible metal tubing which was going out in two and three weeks. Joints have been in service for over five months and customer reports good service to date, expects years more.

SEND FOR YOUR COPY OF THIS COMPREHENSIVE AND INFORMATIVE SWIVEL JOINT CATALOG.

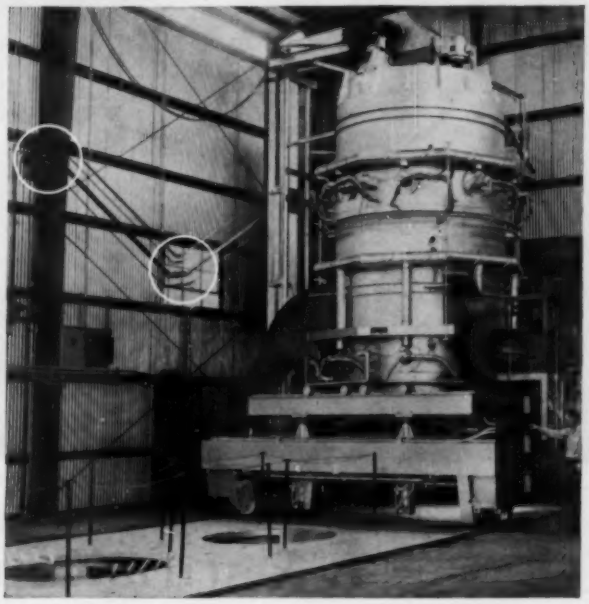
FLEXIBLE CHEMICAL LINES? CHIKSAN HAS THE ANSWER—Providing needed safety for a loading arm to handle sulfuric acid (as this Chiksan joint is doing) or most any chemical is an everyday occurrence with Chiksan joints. Over 2000 different types, styles and sizes in a variety of temperature and pressure ratings are available for your design needs.



RUPTURE PROOF LINES FOR HIGH PRESSURE HYDROTESTING—Critical lines take on a new measure of safety with these flexible steel swivel joints. In service on a pipe testing machine, these lines receive up to 1000 pounds of pressure and more every five seconds as lengths of new pipe move through the testing machine. Only occasional service is required to keep these joints in top working condition.



SWIVEL JOINTED JUMPER SYSTEM SOLVES MANIFOLD PROBLEMS—Moving large quantities of differing liquids from barge to storage tanks posed a problem. A closed system wasn't practical because of contamination due to leakage or accidental opening of a valve. Use of a Chiksan swivel jointed jumper system provided a solution that eliminated cross contamination.



CONSTANT FLOW CHARACTERISTICS ALLOW PRECISE CONTROL—Heat treating furnaces require exacting temperature control. Previous experience with flexible hose indicated too much variation in flow characteristics. By using swivel joints and metal piping, company engineers were able to design a supply line system that insured desired control.

#60-54

fmc **CHIKSAN** COMPANY • 330 NORTH BREA BLVD., BREA, CALIFORNIA

A SUBSIDIARY OF FOOD MACHINERY AND CHEMICAL CORPORATION

Please send me a copy of your latest catalog.

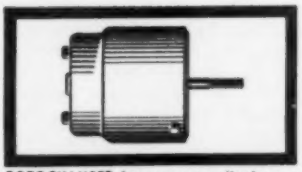
Name_____ Company_____

Title_____ Address_____

City_____ Zone_____ State_____

Fast, Dependable Deliveries Bendix-Westinghouse Power Cylinders

A complete inventory of machined parts—plus unusual manufacturing flexibility—permits us to fill our customers' power cylinder orders *fast*. In emergencies, we have even made same-day deliveries. Furthermore, our broad industrial design and application experience assures you of getting power cylinders exactly tailored to *your* needs. Bendix-Westinghouse piston-type cylinders operate up to 200 psi air and 1800 psi oil and are available in many specialized sizes and mounts as well as in a broad range of standard models. Ask for complete information on industrial products designed and manufactured by Bendix-Westinghouse.



ROTOCHAMBER has neoprene diaphragm, delivers from 900 to 5000 pounds force at 100 psi air pressure.

ROBOTAIR CHAMBER has optional rubber or neoprene diaphragm, delivers from 300 to 3600 pounds force at 100 psi air pressure.

Bendix-Westinghouse BW

INDUSTRIAL PRODUCTS

Bendix-Westinghouse Automotive Air Brake Company, Elyria, Ohio

Decco

D. C. SOLENOIDS FOR MOBILE APPLICATIONS

Special designs from service tested components

Decco industrial quality D.C. solenoids embody the same experienced engineering, high quality construction and dependability of performance as the well known Decco A.C. line.

Decco D.C. units are NOT just D.C. modifications of A.C. units! They are specially engineered and constructed to meet the unique requirements of direct current operation.

Decco D.C. solenoids are of the highly efficient, compact moisture resistant cylindrical-type, single-wound or double-wound with internal switch. They are available in a wide range of force characteristics and stroke lengths.

Decco engineers will gladly advise you on your solenoid problems. Many unusual requirements have been filled, at nominal cost, by adaptation of our standard units. Specials will be built to your specific needs. *Write for catalog 591.*

Decco SOLENOIDS

DETROIT COIL COMPANY

2435 HILTON ROAD, FERNDALE 20, MICHIGAN

NEW NYLAFLOW® PRESSURE HOSE

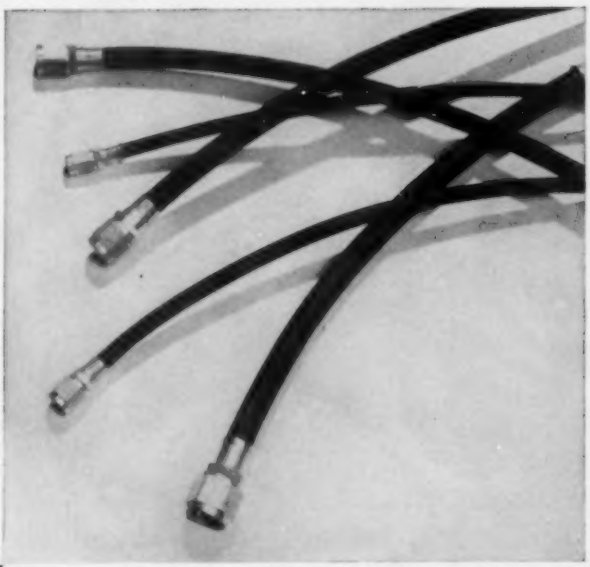
Weighs one-fifth as much... less than half the wall thickness of rubber hose

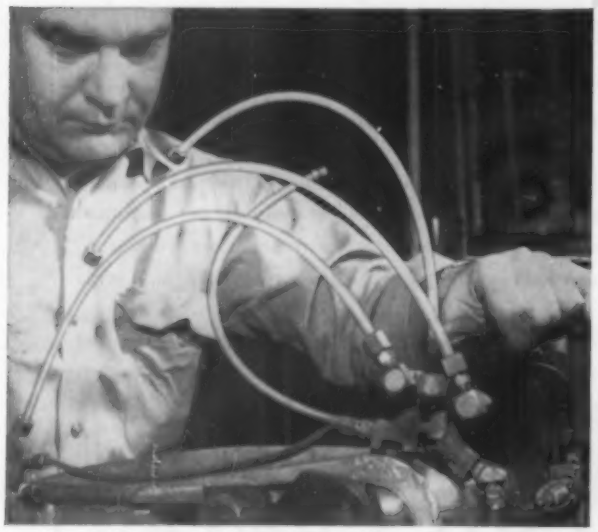
Flexible NYLAFLOW Pressure Hose* is Polymer's newest and best answer to jobs requiring exceptional resistance to flex and vibrational fatigue.

Available in burst pressure ratings of 5000 and 8000 psi., NYLAFLOW Pressure Hose can be supplied in long, continuous lengths and standard inside diameters up to ½" . . . with compact, lightweight, reusable fittings and assemblies if desired.

NYLAFLOW Hose is unaffected by flammable and non-flammable hydraulic fluids, hydrazine and other rocket fuels, and has excellent resistance to almost all organic solvents. Freon permeability is approximately 1/10 that of rubber hose. For use around high voltage lines, NYLAFLOW is an excellent non-conductor.

Odorless, non-toxic, non-corrosive, fungus resistant and will not embrittle in storage. Temperature range (—65°F. to +250°F.). Flexible but can be permanently heat-formed to small, stress-free bend radii.





NYLAFLOW Pressure Tubing in sizes up to ⅜" O.D., with burst pressure ratings of 1000 and 2500 psi., is ideal for lower pressure requirements. It is flexible for easy installation and can be attached with standard flare or compression fittings designed for metallic tubing.

Full details and illustrated brochures now available on new NYLAFLOW Pressure Hose and NYLAFLOW Pressure Tubing. Write today!

*Patents applied for

POLYPENCO® INDUSTRIAL PLASTICS

The Polymer Corporation of Pennsylvania

Export Polypenco, Inc. **Reading, Pa.**

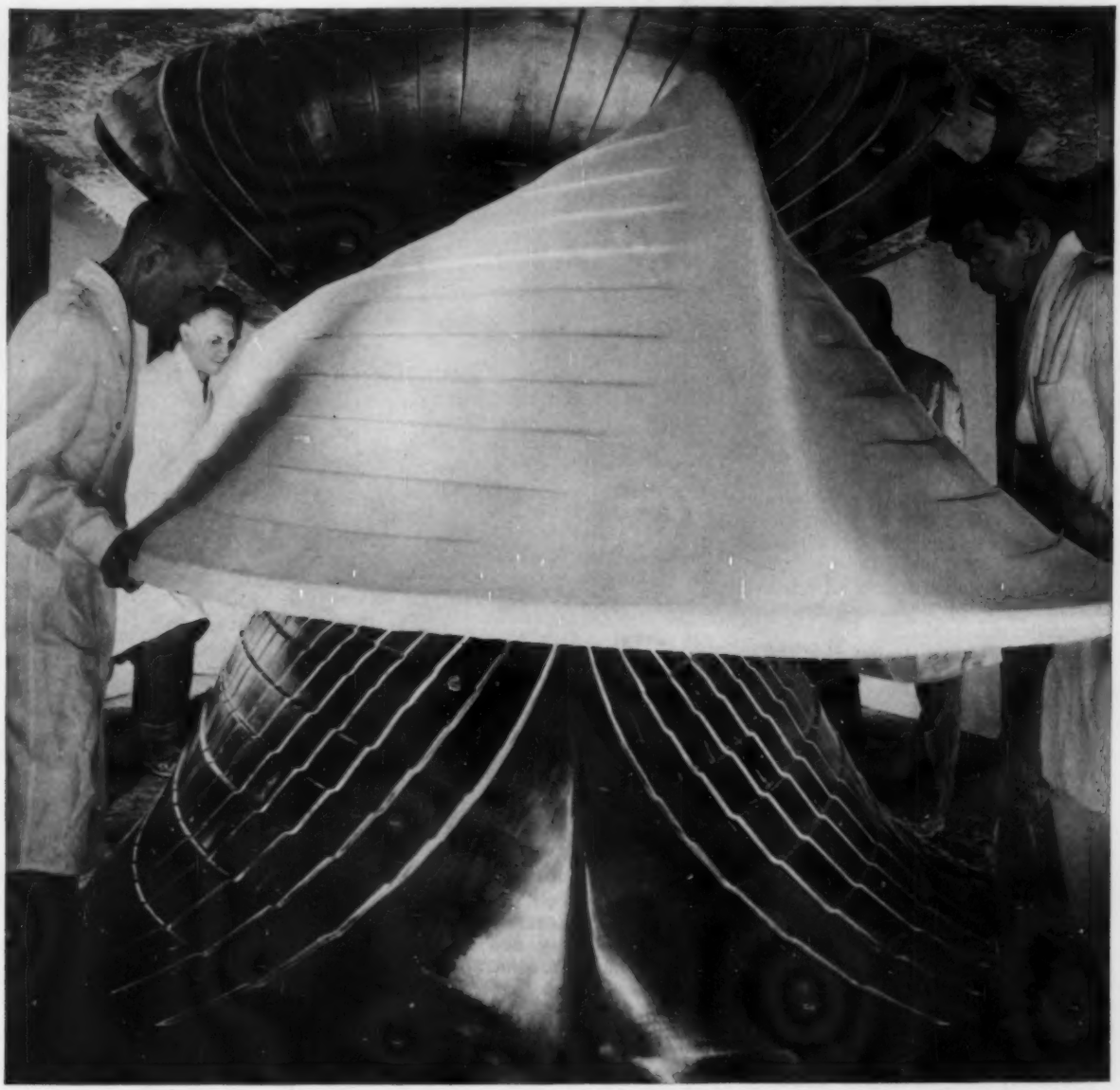


PHOTO COURTESY OF MOLDED FIBER GLASS BOAT CO., UNION CITY, PA.

Birth of a boat–with the help of Sun Hydraulic Oils

You can take it for granted that today's fiber glass boat hulls, molded in giant hydraulic presses, are leakproof. That's one of their greatest virtues. However, it takes top quality hydraulic oils and service to keep these presses at peak efficiency.

That's why your Sun Representative is a good man to have at your side. Widely experienced in solving hydraulic problems, he can spot the causes of difficulties quickly. He'll analyze your requirements for hydraulic oils . . . and recommend the type best suited to your specific needs.

He can do this because Sun produces a wide range of hydraulic oils to accommodate any system, and to keep it in continuous, trouble-free operation.

In fact, Sun offers dozens of quality products designed for specific applications: oils, greases, waxes, and petrochemicals, just to name a few.

You're certain to find the right petroleum product at Sun to meet your most exacting requirements. Write to Dept. AH-9, SUN OIL COMPANY, Phila. 3, Pa. In Canada: Sun Oil Company Limited, Toronto & Montreal.

SUNOCO

Quality...

THE BEST ECONOMY OF ALL

ORIGINATORS OF FAMOUS CUSTOM-BLENDED BLUE SUNOCO GASOLINES

Circle **132** on Time-Saver Card

USEFUL LITERATURE

For your free copy of publications reviewed, fill in the reader service card

AIR-HYDRAULIC BOOSTERS

Handbook describes new line of air-hydraulic, interchangeable boosters. It shows applications and discusses single & double pressure systems, proper tank selection, and production advantages of air-oil circuits. Included are data on actual booster operation, complete selection charts of boosters and cylinders, and hydraulic pressure & flow information. Guide No. 116 also gives tables for calculating thrust force & displacement, and pull stroke force and displacement. *The S-P Manufacturing Corp., Cleveland, Ohio.*

Circle **400** on Time-Saver Card

HOSE, FITTINGS ADAPTERS & COUPLINGS

Twenty-four types of hose and fittings. JIC, SAE, and PTT adapters. Push-pull and screw-type self-sealing couplings. Hose assembly equipment. Dimensional and functional data on industrial uses. Specifications include pressures, temperatures, and bend radii. Hose assembly and installation instructions. Specifications on hand and power assembly of hose. Industrial Catalog 250 has 140 pages. *Aeroquip Corp., Jackson, Michigan.*

Circle **401** on Time-Saver Card

DUAL-SOLENOID VALVES

3-position, 4-way valves have two moving pilot cores and four flexing diaphragms. No spools or closely-fitted parts. No sliding glands, stuffing boxes, stroke settings, or seat regrinding. With both solenoids de-energized, flow is blocked to all orifices. Valve locks cylinder piston at any point of stroke. Brass bar stock body. Poppet-type seats. During cycling, graduated or full cylinder displacement may be controlled by energizing one of the solenoids. Dead-tight sealing on air and liquids. Handle air, water, and oil from 10 to 250 psi. ¼" or ⅜" pipe connections. Mount in any position. Consume 10.5 watts ac, 10 watts dc. All voltages to 550/60, 250 dc. Bulletin 8347. *Automatic Switch Co., Florham Park, N. J.*

Circle **402** on Time-Saver Card

FIRE-RESISTANT FLUIDS

Booklet contains comprehensive data on 32 types of polyalkylene glycol fluids and lubricants. It includes information on physical and physiological properties, physical and chemical analytical methods, storage and handling instructions, and selection. Materials have high viscosity indexes, low pour points, chemical stability with common metals and rubbers. Included are many applications as safety hydraulic fluids and automotive functional fluids. *Union Carbide Chemicals Co., Div. Union Carbide Corp. New York, N. Y.*

Circle **403** on Time-Saver Card

FILTER SIZING

Flow curves show pressure drops based on fluid flow through various filter elements. Procedures describe selection of proper filter for desired particle retention based on fluid viscosity and flow in gpm regardless of system pressure in this 12-page bulletin by *Rosaen Co., Hazel Park, Mich.*

Circle **404** on Time-Saver Card

RAMS & PUMPS

Hydraulic rams have capacities from 10 to 100 tons. Working pressures from 8400 to 9695 psi. More travel for same closed height. Fewer parts. Hand pumps and boosters. Power units have electric motors or gasoline engines. Accessories include fittings, gages, and quick-connect couplings. Bulletin AD-90. *Duff-Norton Co., Pittsburgh, Pa.*

Circle **405** on Time-Saver Card

1⅛" CYLINDER

Lightweight, compact, solenoid operated, cylinder for air, oil, or water operation. Suited for tooling and automation. Unit is stocked in 1", 2", and 3" strokes. Also supplied with solenoid-operated directional valve mounted on head end. Valve has 110-volt, 60 cycle continuous duty coil with grommet type electrical outlet. Power consumption is 10 watts. Cylinder is for use at 150-psi air, 250-psi hydraulic and temperatures of 250 F to −40F. Bulletin No. 458. *The Sheffer Corp. Cincinnati, Ohio.*

Circle **406** on Time-Saver Card

U-RINGS

Molded packings. Single rings used as piston seals. Heavier, larger rings used as ram seals. Cross-sectional drawings show fabric-reinforced construction. Shape bridges piston clearance. Flared walls create lip interference. Increase in fluid pressure exerts spreading action on lips, maintains initial seal. 30-deg bevel. Dimensional cutaway sectional views. Schematic diagrams of typical applications. Bulletin UR-360 shows style numbers, compositions, temperature ranges, and services. Piston and ram seal information on 71 packing sizes. OD from 1" to 21¾". ID from ⅜" to 20". Heights from ⅜" to 1¾". Engineering data includes bore diameters, maximum diametrical clearances, radial packing spaces, groove lengths, and lip diameters. 4 pages. *Greene, Tweed & Co., North Wales, Pa.*

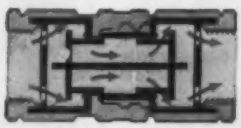
Circle **407** on Time-Saver Card

Continued on page 62

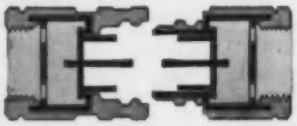
Hey, Herman... Snap-Tite valved couplings come in big sizes too!

There's a size and type to handle almost anything that flows

TO USE SNAP-TITE VALVED COUPLING:



CONNECT—Full flow instantly



DISCONNECT—No flow instantly

Snap-Tite can provide the right size valved coupling for most any use . . . with quick off-on action wherever coupling or shut-off is required.

"H" series valved couplings for high pressure applications. High resistance to heavy line surge. Sizes from ⅛" through 6". Larger sizes on special order.

"IH" series valved couplings for greater impact in air lines. ⅛" through ½".

"E" series valved couplings for vacuum and very low pressure. Recommended for gravity flow. Sizes from ⅛" to 6". Larger sizes on special order.

"T" series valved couplings for hard to handle fluids. The only valved quick-disconnect couplings now on the market for fluid temperatures from −40°F to +400°F. Sizes from ½" through 3".

Snap-Tite valved couplings are available with two-way or one-way automatic line shut-off. They are normally furnished in alloy steel. Also available in brass, aluminum, or stainless steel with a variety of finishes.

Write for Snap-Tite Catalog No. 58 for more information on Snap-Tite valved couplings.

☆ Snap-tite

UNION CITY, PA.

IT-59-60

You get these benefits...

* **prompt delivery**
* **competitive pricing**
* **any external mounting to meet your requirements**

When you BUY VICKERS HYDRAULIC CYLINDERS

Don't miss Booth 107 Production Engineering Show Navy Pier, Chicago, Sept. 6-16

Typical of custom designs that can be furnished readily from Vickers new cylinder facility is this model built with extra rigidity and strength at both rod and clevis ends to overcome side loadings. For added corrosion resistance, stainless steel clevis pins, piston rods, retaining screws and grease fittings are used.

Standard Models for Operation to 3000 psi

Choose the cylinder "outside" that's best for your installation—Vickers offers you a wide selection of standard mountings plus an almost unlimited range of special configurations. Alternate rod end threads . . . straight thread port connections . . . extra barrel lengths for bearing support . . . are among many available options.

- Working pressures to 3000 psi (non-shock)
- Hard chrome plated, ground and polished, high-strength alloy steel piston rods.
- Large ports hold pressure drop within desirable limits.
- Fast, accurate parts replacement is assured because all cylinders are individually registered.
- Honed barrels of heavy walled seamless tubing minimize friction and wear.
- Cushions can be provided—either head, rod or both ends.
- Your choice of automotive step-cut piston rings for maximum life or low friction "T" rings for applications requiring minimum leakage. Full size cast iron piston for maximum bearing support with either type seal.
- Synthetic rubber wiper ring is standard—metallic wipers available.
- Two large wrench flats on rod are standard—additional flats available on request.
- Fully meet JIC specifications.

New, separate plant facilities—devoted exclusively to the design and manufacture of hydraulic cylinders—assure prompt individual attention to your orders. Service stocks are maintained at all Vickers warehouses in the U.S. and Canada. For more application data and installation dimensions, call or write today for Bulletin 60-68

VICKERS INCORPORATED

DIVISION OF SPERRY RAND CORPORATION

Machinery Hydraulics Division

ADMINISTRATIVE and ENGINEERING CENTER

Department 1474 • Detroit 32, Michigan

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CHICAGO (Area) POrter 6-2900	**HOUSTON** JAckson 2-9623	**NEW YORK (Area)** DRexel 6-3500	**ROCKFORD** WOodland 2-0615	**WORCESTER** SWift 8-3706

8903

Standard Models for Operation to 3000 psi

USEFUL LITERATURE

MACHINING TEFLON

This booklet discusses stress relieving; use of tools and coolants; feed speeds and rates; rakes, angles, and clearances; burrs and chips; turning, boring, drilling, tapping, reaming, counterboring, and grinding; fly cutting; surface finishes and tolerance. "Basics in the Machining of Teflon"—Plastics Products Div.—*Raybestos-Manhattan Inc., Manheim, Pa.*

Circle **408** on Time-Saver Card

STRAINERS

Fit lube oil, hydraulic, or air lines. Remove scale, core sand, metal chips, or construction dirt. Insert in lines at any flanged joint. Flanged housing available. Steel hardware. Phosphor bronze media. Phosphate coated after assembly. Maximum operating temperature is 250 F. *Air-Maze Corp., Cleveland, Ohio.*

Circle **409** on Time-Saver Card

POWER STEERING SYSTEMS

A complete line of power steering components to suit virtually any steering axle load requirements. Interchangeability of various components sizes, numerous pumps, servo valves, and cylinders allow design flexibility in remote or integrel steering linkage systems. Selection tables, performance curves, and typical examples of steering component selection are illustrated in bulletin No. M-5110. *Vickers Inc. Division of Sperry Rand Corp., Detroit, Michigan.*

Circle **410** on Time-Saver Card

HYDRAULIC PUMPS VALVES, CYLINDERS

Bulletin No. 6000 includes information on 2-way and 4-way directional valves in sizes of ¾" to 1½" for 3000-psi systems. Valves are for manual, cam, foot, solenoid, oil, and pilot operation. Also listed are relief, sequence, unloading, pressure reducing, counter-balance, and check valves.

The cylinder line has 1½" to 12" bores for 300, 2000, or 3000 psi—available with standard 2:1 piston rods, with or without cushion.

Fixed displacement pumps and motors are shown in capacities of 2 to 120 gpm at 1000 psi; radial piston, variable displacement pumps and motors in capacities of 5 to 185 gpm at 3000 psi, and power units with reservoir capacities from 7 to 200 gallons. *The Hydraulic Press Mfg. Co., Div. Koehring Co., Mount Gilead, Ohio.*

Circle **411** on Time-Saver Card

BAR & TUBING

Bar & Tubing Digest includes material which helps designers determine which bars and tubing to specify. Application articles. First issue has reference chart of cold drawn bars. *Columbia Steel & Shafting Co., Carnegie, Pa.*

Circle **412** on Time-Saver Card

ROTARY SHAFT SEALS

Engineering applications of compact, ready-to-install seals are described in Bulletin AD-150 which outlines temperature, pressure, shaft speeds and other factors critical in the selection of mechanical sealing devices. One table lists standard sizes of seals, another shows types of construction of various seals together with available standard and optional features. Examples of typical applications and engineering specifications are also included. *Garlock Inc., Palmyra, New York.*

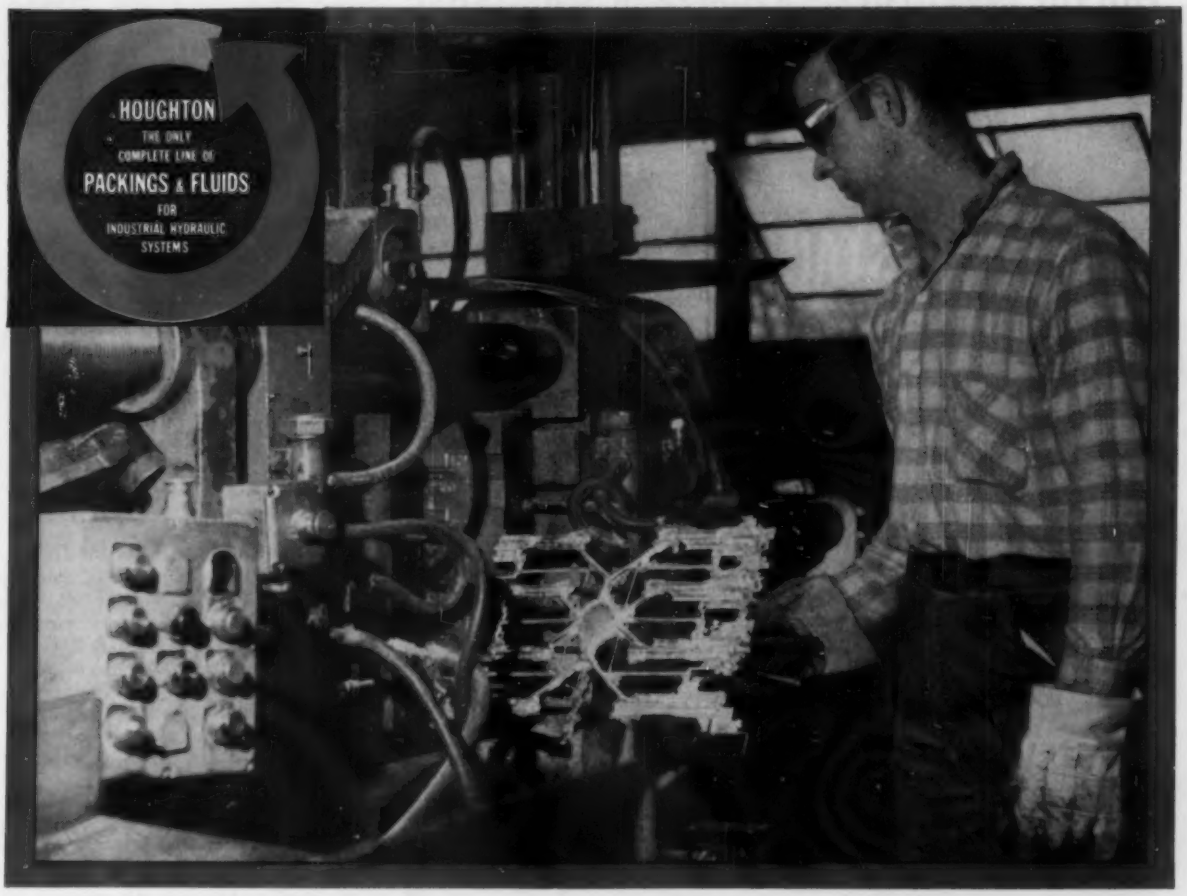
Circle **413** on Time-Saver Card

POROUS METAL

Porostrand is made by winding stranded and solid wires, side by side and layer on layer. As many layers as required for thickness, strength, and permeability. Sintering joins solid and stranded wires at all contact points along entire length. Open areas between solid wire and strands form pores. Nominal 10 and 30 microns. Absolute 25 and 60 microns. Lengths from ¾" to 120". Diameters from ¾" to 48". Temperature rating and corrosion resistance depend upon wire material. Bulletin BFD-180 covers filtration and other applications. 2 pages. *Bendix Filter Div., Bendix Corp., Madison Heights, Mich.*

Circle **414** on Time-Saver Card

Continued on page 64



SIX YEARS WITHOUT DRAINING . . .

a lesson in safe hydraulic fluid economy

Since 1954, four 400-ton die casting machines like this one operated continuously on *their initial fill* of Houghto-Safe Hydraulic Fluids. Only make-up was needed to maintain proper fluid level. And each machine operated more than 3000 hours every year.

What better example of the important *extras* you get in *fortified* Houghton Fire Resistant Fluids? In addition to fire-safety, the built-in lubricity, oxidation stability, and corrosion resistant characteristics of Houghto-Safe fluids kept machine maintenance costs to a minimum. Performance was comparable to that of the finest petroleum oils . . . with the added advantage of fire-safety.

Houghto-Safe *fortified* fluids can give your hydraulic equipment and plants this same economical protection. And with it you get completely unbiased hydraulic service from the only manufacturer who offers three types of fire-resistant fluids (Water-Glycol, Phosphate-Ester and Emulsion Types) with compatible packings for any industrial hydraulic service.

FREE! 48-page Handbook of authoritative and helpful information on selection and application of fire-resistant hydraulic fluids and compatible packings. Write E. F. Houghton & Co., 303 W. Lehigh Ave., Phila. 33, Pa.

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FOR THE BEST IN HEAT TRANSFER PERFORMANCE

Yates-American

FIXED BUNDLE

STAINLESS STEEL HEAT EXCHANGERS

FOR CORROSIVE TYPES OF HYDRAULIC OILS...

- Stainless Steel Construction . . . all parts in contact with fluids . . . of Type 316 stainless steel.
- Rolled tube joints . . . industry's preference and standard of quality construction.
- Tube pattern . . . allows for use of wider, heavier gaskets for critical conditions of temperature and pressure.
- Wider range of capacity . . . ¼" and ⅜" tube sizes . . . unit sizes 2" to 10" diameter.
- Write for Bulletin HT-21

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FIXED BUNDLE

HEAT EXCHANGERS

FOR BROADEST HEAT TRANSFER APPLICATIONS

- Flanged baffles . . . pioneered by Y-A eliminate vibration wear and provide maximum efficiency.
- Rolled tube joints . . . industry accepted standard of quality construction.
- Single and Multiple Pass Designs . . . available in 2" to 8" diameters.
- Popular sizes now available from stock.
- Ask for Bulletin HT-1A.

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ENGINE COOLING RADIATORS

FOR ALL TYPES AND SIZES OF DIESEL ENGINE APPLICATIONS

- Die-drawn, cast, or fabricated construction.
- Complete range of efficient cores.
- Application engineered for specific conditions.
- Panel or sectional construction.

Y-A Engineers are always available to assist in the most practical and economical solution for your heat transfer problems in heating or cooling applications.

Over 75 years of service to industry

HEAT TRANSFER DIVISION

Yates-American MACHINE COMPANY

705 4th St. BELOIT, WISCONSIN

Circle **159** on Time-Saver Card

USEFUL LITERATURE

STORAGE CABINETS AND RACKS

Steel cabinets and racks store fittings, hose, and reusable hose ends in one convenient place. Compact cabinets keep stocks readily available. Stock identification and inventory is simple and quick. Bulletin Form 6175—*The Weatherhead Co., Fort Wayne, Ind.*

Circle **415** on Time-Saver Card

LIFT TRUCK ACCUMULATOR

Accumulator cushions lift truck loads help avoid spillage & breakage and reduces damage to lift mechanism. A cylindrical vessel with a floating piston separator between pressurized gas on one side, and hydraulic fluid on the other side provides a shock absorber system. Described in Bulletin 1630B2. *Parker Hydraulics Div., Parker-Hannifin Corp., Cleveland, Ohio.*

Circle **416** on Time-Saver Card

PLASTIC STOCK SHAPES

Stock availability of plastics are described and listed in Bulletin BR-1. Data on properties and applications of mill shapes of nylon TFE fluorocarbons, polycarbonates, chlorinated polyethers, cross linked polystyrene nylon pressure hose & tubing is included. *Polymer Corp., Reading, Pa.*

Circle **417** on Time-Saver Card

REUSABLE LOW PRESSURE HOSE FITTINGS

Data on reusable, low-pressure hose couplings. Also union swivel adapters, hose assemblies in 1 or 2 rayon braid with reusable couplings. Connectors, male and female hose stems, joiners, adapters, hex pipe nipples, and pipe reducing connectors are described in this catalog. *The Lenz Co., Dayton, Ohio.*

Circle **418** on Time-Saver Card

For more reviews of FREE LITERATURE turn to page 163

One good Le Roi leads to another ...user reports

One of the machines served by the Le Roi 75S2 is the rivet drilling machine. The operator is shown gauging one of the drilled tubular rivets prior to finishing.

LE ROI 75-HP STATIONARY COMPRESSOR

First air-cooled Le Roi finishes 5 years of service with just routine cleaning and oil changes!

Shown above is a Le Roi 75S2 compressor recently installed at John Hassall, Inc., Westbury, Long Island, manufacturer of job-designed fasteners and parts.

Picking Le Roi came naturally when Hassall found need for additional air power. Their last Le Roi has worked for five years without trouble, and has required only filter cleaning and oil changes for upkeep.

Hassall was convinced they could save 30% on installation, get more air from less space, and reduce maintenance time about 40% if they installed the air-cooled Le Roi 75S2 rather than a water-cooled air compressor.

Moreover, Le Roi compactness permits installation *near the point of use*, with less piping and air loss. Air-cooling eliminates costly plumbing and water-line freeze-ups... permits indoor or outdoor installation. Dual control gives you constant speed or automatic start-stop operation.

Pick Westinghouse unit-type or Le Roi stationary air compressors for your needs. Sizes from ½ to 100 hp. See your Le Roi distributor, or write to Le Roi Division, Westinghouse Air Brake Co., Sidney, Ohio.

SC-67

LE ROI STATIONARY COMPRESSORS

PORTABLE AND TRACTAIR® AIR COMPRESSORS • STATIONARY AIR COMPRESSORS • AIR TOOLS

How B&W JOB-MATCHED LECTROSONIC* J.I.C. TUBES solve hydraulic fluid line problems

New J.I.C. Standards approve welded carbon steel tubing for hydraulic fluid lines—and B&W makes such tubing—

Five quality control checks—including 100% ultrasonic inspection — help assure you maximum dependability from B&W Job-Matched Lectrosonic J.I.C. Hydraulic Fluid Line Tubing. You get:

- . . . a full range of sizes and dimensional exactness and uniformity — matched to your job in every detail
- . . . controlled mechanical properties — to give ease of fabrication and save you installation time
- . . . long, trouble-free service life — even in the most exacting applications

B&W will be glad to help you select exactly the right tube for efficient, economical service. Call your local B&W District Sales Specialist, or write for Bulletin 435 for full information. The Babcock & Wilcox Company, Tubular Products Division, Beaver Falls, Pennsylvania.

*Welded Carbon Steel Tubing

B&W

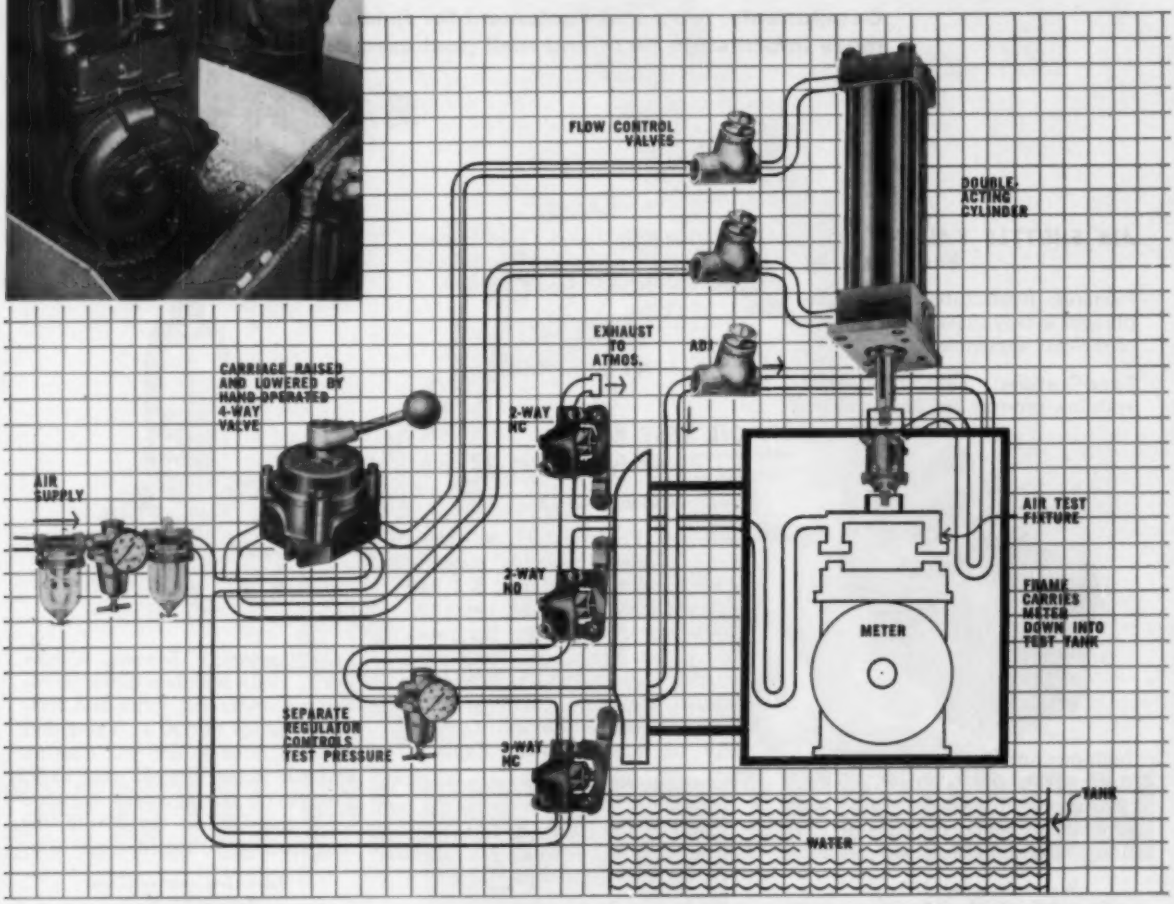
THE BABCOCK & WILCOX COMPANY

TUBULAR PRODUCTS DIVISION

TA-9039-WM3

Seamless and welded tubular products, solid extrusions, seamless welding fittings and forged steel flanges—in carbon, alloy and stainless steels and special metals

Here's how one company tests its products with air. This air circuit of Schrader Products at the Sprague Meter Company in Bridgeport, Connecticut, automatically clamps meter ports airtight, lowers meter into water, and fills it to test pressure. Operator looks for telltale bubbles from leaks, then presses lever to raise meter automatically. Says the Plant Manager: "This used to be a slow, arduous process. Now a meter's in the water, under pressure, in less than a second."



MANUFACTURER SETS UP CRITICAL TEST IN LESS THAN ONE SECOND— WITH SCHRADER AIR PRODUCTS

As products grow more complex and precise, many manufacturers are *simplifying* their operations—with air cylinders, valves, fittings and simple schematic planning. They're installing their own circuits, as this manufacturer did, or letting Schrader experts help. For example, Schrader Air Products can inspect, test, assemble, package—do work faster, more accurately—save effort and money.

Never forget air can make almost any motion human hands can—push, pull, hold, position, or move repetitively. And air doesn't get tired—has more powerful muscles. Maintenance? Almost nil.

Take full advantage of your air power by automating with Schrader—the most complete line of Air Cylinders, Valves, and Accessories. Schrader engineers have experience and know how to help you cut your operating costs.

Select your automating equipment from the full Schrader line. Your Schrader distributor can help you pinpoint what you need. For more data, write:

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456 Vanderbilt Avenue, Brooklyn 38, N. Y.

QUALITY AIR CONTROL PRODUCTS

NEW PRODUCTS

Components, tools and equipment for fluid power systems. For more information fill in and mail post card bound in this issue.

AIR SHUTTLE VALVE . . . has no spring

Features: Replaceable rubber diaphragm is only moving part. Made of die-cast aluminum.

Specifications: 1-psi differential seals low-pressure line and connects

high-pressure line to outlet. Weighs 6 oz. Ports are ¾" or ¼" NPT. Maximum air-pressure 200 psi. Operating temperature, −40 to 160 F (to 200 F intermittent).

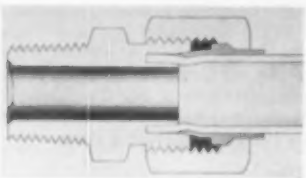
Westinghouse Air Brake Co.
Industrial Products Div.
Wilmerding, Pa.

Circle **300** on Time-Saver Card

STEEL FITTING . . . for plastic tubing

Designation: Self-Lock

Features: Does not pull out or blow out. For thin wall type "T" and



heavy wall type "H" nylon tubing. Steel, brass, aluminum, and stainless steel fittings in all commercial shapes and sizes. Internal tube support prevents collapse of tube wall, as fitting is tightened. Collet fingers of precision sleeve hold outside of tube. No special tools needed.

Flodar Corp.
Cleveland, Ohio

Circle **301** on Time-Saver Card

OIL TEST KIT . . . analysis takes 12 min.

Designation: Akra-Ez

Features: Finds acidity, viscosity, water content, insoluble contaminants, and temperatures. Kit has magnets for determining viscosity, hand-sling centrifuge, magnetic device for metallic contaminants, titration equipment for acidity. Manual explains kit, so that non-technical people can use it. Tells why oil breaks down. Explains

significance of viscosity, acidity, heat, and contamination. Charts for plotting viscosity and acidity.

R & W Engineering Service Co.
Anaheim, Calif.

Circle **302** on Time-Saver Card

VENTURI-TYPE VALVE . . . is direct-acting

Designation: V-20000-04

Features: Venturi's pressure-recovery characteristics allow reduction of fluid line ID. Permits light, direct-acting solenoid. Floating-seal disc is self-cleaning, self-lapping. High-temperature insulation. Mechanical and thermal shock do not affect coils.

Specifications: 1" line size. Weighs 1-¾ lb. Coils maintain dielectric resistance under salt spray and temperatures up to 500 F. Valve and solenoid rated to 255 psi, over an ambient range of −65 to 250 F. For fluid temperatures between −30 and 350 F (to 550 F for maximum of 10 minutes).

Valcor Engineering Corp.
Kenilworth, N. J.

Circle **303** on Time-Saver Card

AIR-PRESSURE REGULATOR . . . for high & low ranges

Features: High and low-range springs. Automatic internal relief. Aluminum housing. Internal parts are brass. Buna N diaphragm is nylon reinforced. Steel springs are cadmium plated. Buna N made O rings are replaceable. Oversize control valve. Large air passages. Flow through regulator helps maintain regulated pressure without limiting capacity. Can be used as shut-off valve.

Specifications: For 5 to 125 psi. Pipe sizes ¼" and ⅜" NPT.

Perfecting Service Co.
Charlotte, N. C.

Circle **304** on Time-Saver Card

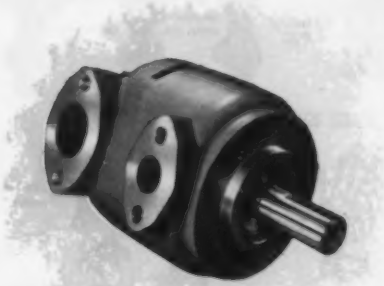
For more NEW PRODUCT reviews turn to page 146

VANE PUMP POWER

for

CATERPILLAR products

2000 PSI...BY DENISON



2000 PSI HYDRAULIC PUMP

... is incorporated into power systems of dozens of types of earthmoving equipment by leading manufacturers. Denison 2000 psi hydraulic power gets jobs done faster with dependable trouble-free operation for toughest workloads.

Here's the quick, smooth action of Caterpillar's No. 955 Traxcavator with exclusive new "side dump bucket". Built to operate at *full capacity* 'round-the-clock, this Cat-built excavator-loader is another of many construction units factory-equipped with advanced Denison hydraulic equipment.

The new side dump bucket – powered by a single Denison 2000 psi vane pump—allows "in-line" loading ... reduces that job to a straight forward-backward operation, *cutting operating cost significantly.*

The compact Denison *vane pump* delivers continuous, trouble-free hydraulic power for *faster load-and-dump cycles* ... plus powerful *breakout action* and plenty of reserve "go" for toughest workloads.

The key is *continuous,* high volumetric efficiency in Denison pumps. Result: no drop-off in work speed ... no sluggish operation to slow up the job.

Plus these advantages—"cartridge" construction means speedy in-field servicing. All-weather starting feature prevents pump damage. And Denison pumps guarantee less weight, less cost-per-horsepower ... more payload-per-dollar in your earthmoving equipment.

Your Denison Hydraulic Specialist can tell you more about improving equipment performance with *hydraulic power to 5000 psi.* Call him in now to discuss *making your equipment more profitable to the man who buys it!*

DENISON ENGINEERING DIVISION
American Brake Shoe Co.
1166 Dublin Road • Columbus 16, Ohio

DESIGNERS ENGINEERS...

Write for your copy of Bulletin P-9-1-A on Denison "TD" Series Vane Pumps. Includes complete specifications and operating data.

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DENISON HydrOilics

HYDRAULIC PRESSES • PUMPS • MOTORS • CONTROLS

BARKSDALE AIR-SEAL* VALVES

LOW PRESSURE AIR TO 250 P.S.I.

. . . over 200 different valves available.

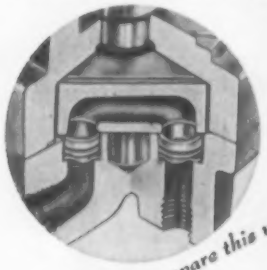
The air pressure is the sealing force . . . the higher the pressure, the tighter the seal.

Why so many different air valves?

Because air valve requirements vary with the method of actuation. A basic valve with interchangeable actuators cannot possibly meet ALL your specific applications without compromise. For example: A solenoid valve designed for speed would not have the stamina required of a manual or foot valve.

The Barksdale line of AIR-SEAL Valves has been designed with your requirements in mind. All our valves have been engineered for best performance from your point of view . . . for YOUR specific need, and not to make OUR job easier.

MANUAL and FOOT OPERATED "SHEAR-SEAL" VALVES



No oilers and filters needed — not critical to dirt and corrosion — made from non-corrosive materials.

Years of leakproof service — without constant maintenance — Self aligning "Shear-Seal" design compensates for normal wear.

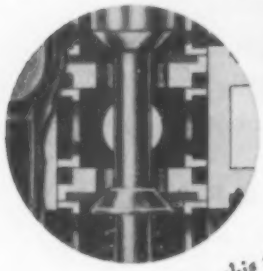
compare this with conventional

SPOOL or PLATE VALVES

Alignment is critical — dirt and corrosion cause sticking.

There is no compensation for normal wear — leakage increases with use.

SOLENOID-PILOT CRESCENT® (Self-aligning poppet) VALVES



Quick response (12 milliseconds) due to short travel of poppets and solenoid.

Tight sealing — self-aligning, self-scavenging design adjusts to normal wear — not critical to dirt and corrosion — non-corrosive materials throughout.

No coil burnout — heat dissipating "integral" design.

compare this with conventional

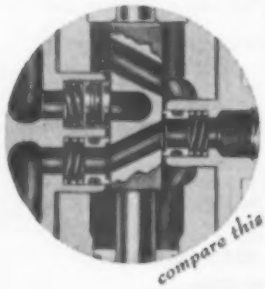
SPOOL VALVES

Slower response due to long spool travel.

Leakage increases with use — dirt and corrosion particles are ground-in between spool and seals—Sticking!

Overheating causes coil burnout — poor heat transfer of "unitized" design.

DIRECT-SOLENOID OPERATED "SHEAR-SEAL" VALVES



Leakproof for years of service — self-adjusting to wear.

No coil burnout — because valve does not freeze up.

compare this with conventional

SPOOL VALVES

Dirt enters spool clearances — develops leaks — causes sticking — sticky valves are to blame for most solenoid burnout.

Write for Air Valve Catalog 9-AV

CONTROL VALVE DIVISION

Barksdale valves

5125 ALCOA AVENUE • LOS ANGELES 58 • CALIFORNIA

MANUALLY OPERATED

4-Way valves ¼ to 1½" N.P.T. with or without spring return

Shut-off valves ⅛ to 1" N.P.T. with or without spring return

FOOT OPERATED

4-Way valves ¼, ⅜ and ½" N.P.T. with or without spring return

SOLENOID-PILOT

4-Way valves ⅛ to ¾" N.P.T. A.C. and D.C. Standard

Explosion-proof

J.I.C. type

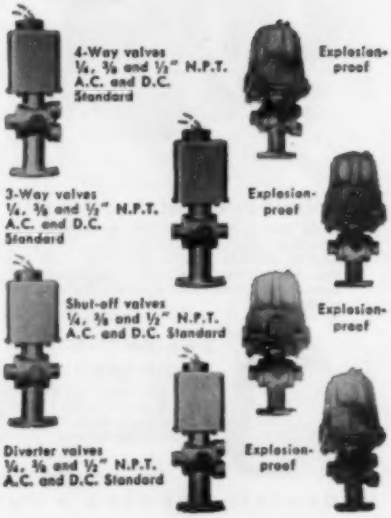
With manual override

3-Way valves ⅛ to ¾" N.P.T. A.C. and D.C. Standard

With manual override

Explosion-proof

DIRECT SOLENOID



4-Way valves ¼, ⅜ and ½" N.P.T. A.C. and D.C. Standard

Explosion-proof

3-Way valves ¼, ⅜ and ½" N.P.T. A.C. and D.C. Standard

Explosion-proof

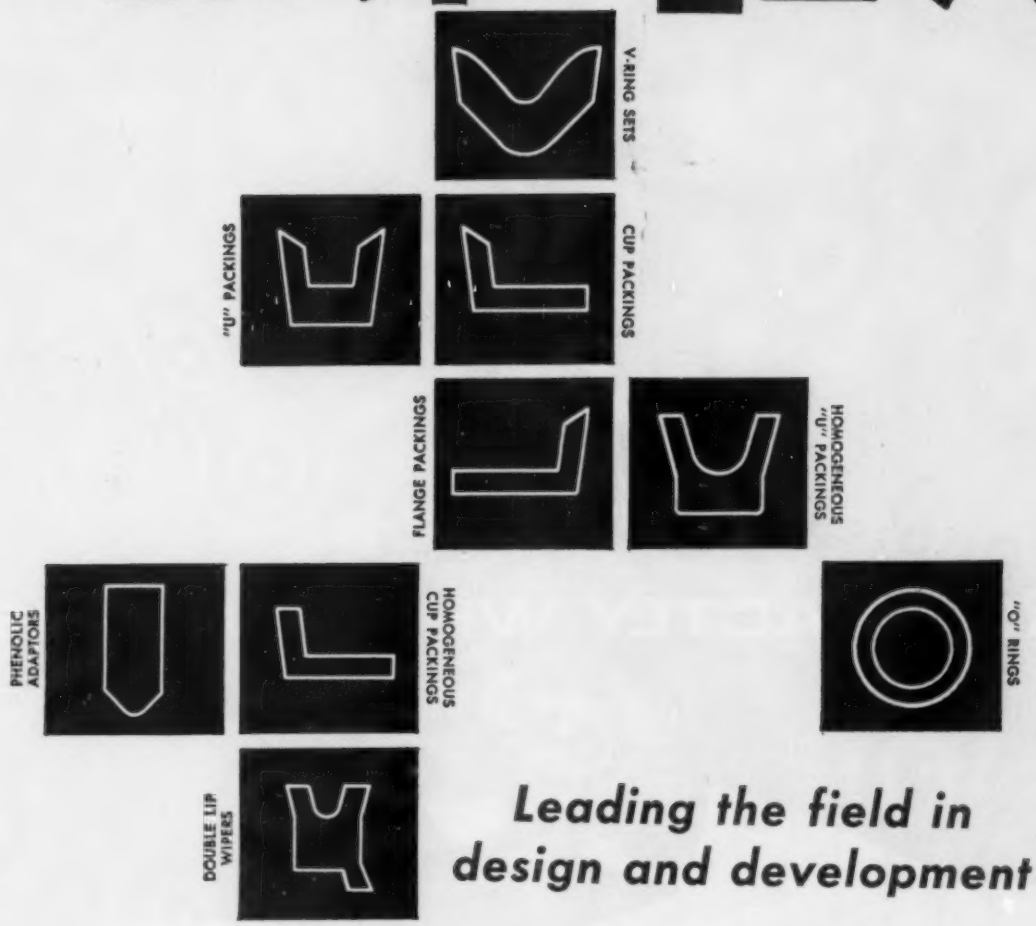
Shut-off valves ¼, ⅜ and ½" N.P.T. A.C. and D.C. Standard

Explosion-proof

Diverter valves ¼, ⅜ and ½" N.P.T. A.C. and D.C. Standard

Explosion-proof

PERiFLEX



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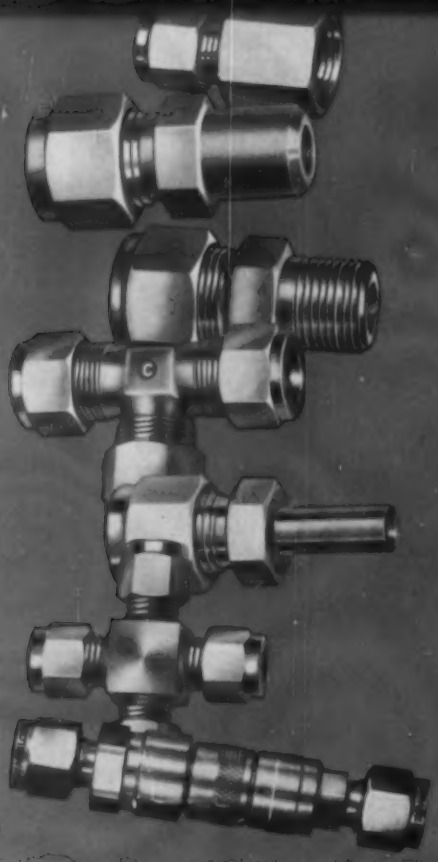
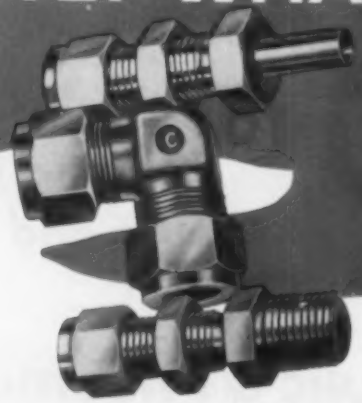


Swagelok®

HAS EXACTLY WHAT YOU NEED



Complete selection of shapes
for 1/8" through 1" O. D. Tubing
Available in all machineable metals & plastics
No special tools needed for installation
No special preparation of tubing
1¼ turns provides torque-free vacuum tight seal

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CRAWFORD FITTINGS (CANADA) LTD., NIAGARA FALLS, ONTARIO, CANADA

Fluid Power Society forms chapters

TWO CHAPTERS of the newly formed Fluid Power Society are now organizing in Detroit and Milwaukee. The Detroit group has developed from the former Industrial Hydraulics Training Association which has been active in that city since 1957. It was organized originally by a group of instructors of industrial hydraulics to further education in fluid power. The Milwaukee chapter is an outgrowth of the activities of the Milwaukee School of Engineering which has held classes and seminars on fluid power subjects.

First chapter meeting in Detroit is scheduled for September 23 at the Ford Sterling plant. Officers will be elected and a program of activities outlined. Further information is available from George Altland, Vickers, Inc., Detroit 32.

A steering committee of the Milwaukee chapter met on July 20 and again on August 10. First chapter meeting will be held September 28 to elect officers and appoint committees. Russ Henke, chairman of the steering committee, has further information about the meeting. His address is P. O. Box 554, Elm Grove, Wisconsin.

A chapter is now forming in Chicago under the guidance of Dr. Milton Goldstein, Dean of the American Institute of Engineering and Technology, 1135 W. Fullerton Ave., Chicago 14. The group plans an organizational meeting on September 13.

A Cleveland group is also meeting to plan organization of a chapter. For further information, contact HYDRAULICS & PNEUMATICS editor, Allan Morris.

• **Annual Meeting Date Set**—First annual meeting of the Fluid Power Society will be October 19th at the Sherman Hotel in Chicago. This has been planned just before the National Conference on Industrial Hydraulics to simplify attendance at both affairs. It is expected that many of those coming to the conference will plan to arrive a day early to attend the Society meeting which is open to non-members. Barrett Rogers, 5595 N. Hollywood Ave., Milwaukee 17, executive vice president of the Fluid Power Society, it in charge of arrangements.

Organization of the Fluid Power Society has been assisted by the National Fluid Power Association whose members are manufacturers of hydraulic and pneumatic components. Together with designers of fluid power equipment, they have recognized the need for an organization devoted entirely to this field, with membership open to those with an interest in fluid power. The Society will include men from the production equipment, aircraft, and mobile equipment fields, as well as the many other industries where hydraulics and pneumatics is used. It will bring together those concerned with research and development, design, application, installation, and maintenance of fluid power systems and components.

SEND IN THIS APPLICATION FORM TODAY

FLUID POWER SOCIETY

5595 N. Hollywood Avenue, Milwaukee 17
Wisconsin, WO. 2-9950

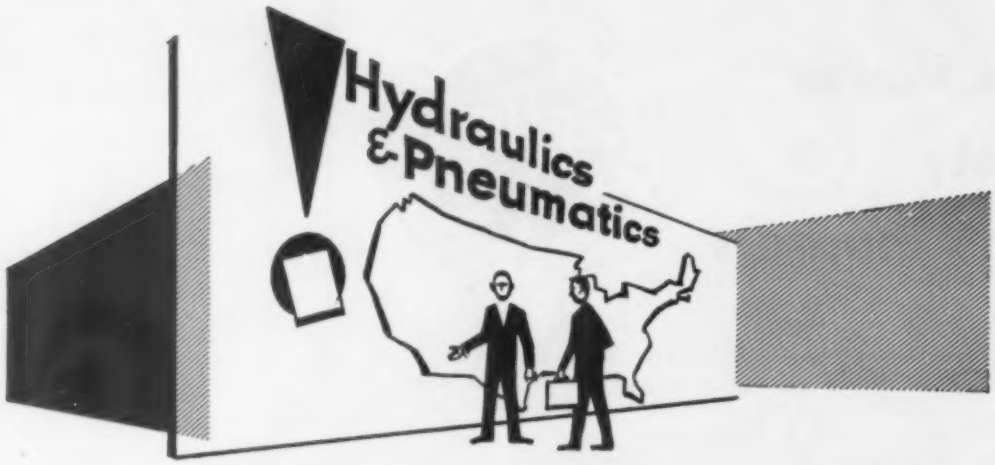
I hereby apply for membership in the Fluid Power Society. If this application be duly approved, I agree to be governed by the Constitution and By-Laws of the Society, and to further its objectives as laid down therein.

1. Name _____ Last _____ First _____ Middle _____
2. Home Address _____ Street _____ City _____ Zone _____ State _____
3. Name of Employer _____
4. Business Address _____
5. Nature of Business _____
6. Applicant's Title or Occupation _____
7. Address for Fluid Power Society Mail (check one) Home ____ Business ____

Enclosed is my check for $10 which includes $5 membership application fee and $5 annual dues.

Date _____ Signed _____

← Circle 41



...Along the aisles

PRODUCTION ENGINEERING SHOW • CHICAGO
SEPTEMBER 6-16

Booth

481 A & A Mfg. Co. Inc.
308 Acro Div., Robertshaw-Fulton Controls Inc.
483 Airmatic Valve, Inc.
251 Alemite Div., Stewart-Warner Corp.
216, 218 Allen-Bradley Co.
480 American Sealants Co.
132, 134 Automatic Switch Co.
529 Cuno Engineering Corp.
406 R. B. Denison Mfg. Co.
381 Eagle Signal Co.
512 Gast Mfg. Co.
450 Imperial Brass Mfg. Co.
253 Marvel Engineering Co.
271 Micro Switch, Div. Minneapolis-Honeywell Regulator Co.
106, 108 Miller Fluid Power Div. Flick-Reedy Corp.
308 Mo-Bar Hydraulic Sales Co.
331 Moog Servocontrols, Inc.
435 Owatonna Tool Co.
405 Purolator Products, Inc.
220 Ross Operating Valve Co.
212, 214 Skinner Electric Valve Div., Skinner Chuck Co.
232 Standard Pressed Steel Co.
159, 161 U. S. Electrical Motors, Inc.
107 Vickers, Inc.
355 Watts Regulator Co.
301 Westinghouse Air Brake Co., Industrial Products Div.
421 Wilton Tool Manufacturing Co., Inc.

481 A & A Mfg. Co. Inc.

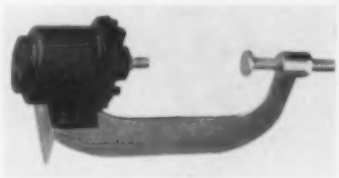
You'll see . . . Bellows-type, pliable protectors formed by vulcanizing edges of neoprene-coated nylon materials. Oil-tight and air tight. Made in any

size or shape. Will cover piston rods, spindles, vertical, or horizontal screws and all shapes of machine-tool ways and cross-rails.

Circle **200** on Time-Saver Card

483 Airmatic Valve Inc.

You'll see . . . A 2-way ball cam valve and a 3-way palm-button valve, with ⅛" and ¼" orifices (0-200psi). Air



operated C clamps. 3-way, 2-position air control sleeve valve. Pneumatically-operated, solenoid-actuated, positive-displacement metering pump with adjustable capacity from 0 to 6.44 cc.

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480 American Sealants Co.

You'll see . . . Sealant for threaded and tube joints. Easy to apply. Requires no mixing and has an unlimited pot life. Hardens only in the joint. Excess may be wiped off. May be used with water-glycol, chlorinated, and phosphate ester hydraulic fluids.

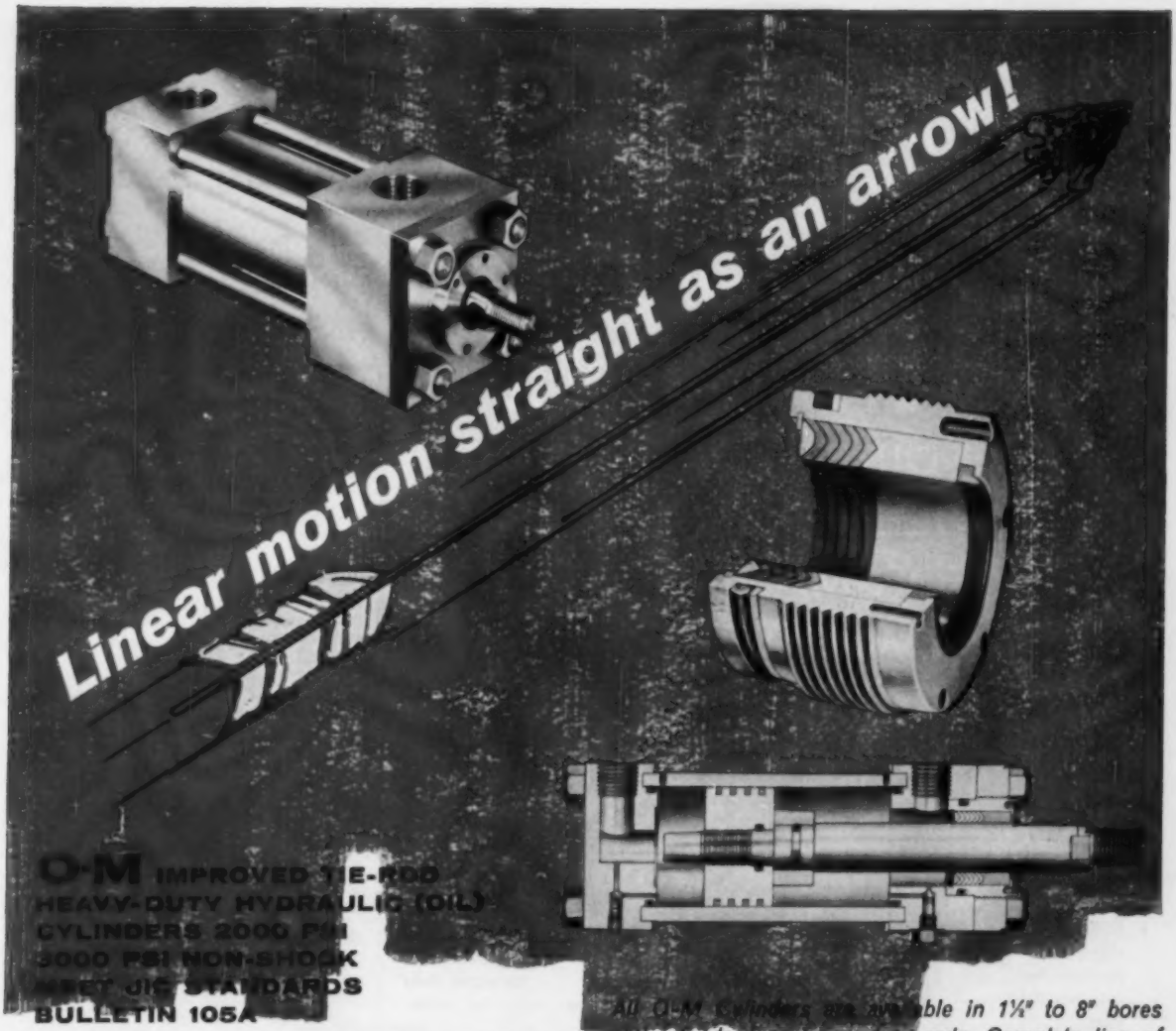
Circle **202** on Time-Saver Card

132, 134 Automatic Switch Co.

You'll see . . . A 4-way, 2-position solenoid valve with ¼" orifices. Forged brass body. Poppet-type seats and discs. Main valve discs power driven in both directions. No return springs necessary. Valve operates in air, water, or hydraulic oil. Pressures to 250 psi. Can be mounted in any position.

Circle **203** on Time-Saver Card

Continued on page 76



MAINTAINING perfect piston rod alignment on thrust and return strokes is an engineering advantage of all O-M Air and Hydraulic Cylinders. But this is not the only reason why Design Engineers specify these components. For example, O-M Cylinders are all steel with bronze bearings . . . are cushioned to relieve piston shock . . . make full-power starts, and the length of each stroke can be held to the tolerance desired. In addition, O-M Cylinders can be mounted to deliver maximum performance in a horizontal, vertical or inclined position, and ports oriented to a convenient location.

These and many other advantages of O-M Cylinders are covered in our 1960 Bulletins with construction and dimensional details, engineering drawings, capacity chart and mounting data. For your copies, MAIL COUPON TODAY.

Bulletin 101A—Internal Key Tie-Rodless-Type Cylinders. Air 150 psi; Hydraulic up to 1500 psi.

Bulletin 105A—Improved Tie-Rod (Heavy Duty) Cylinders Hydraulic 2000 psi; 3000 psi non-shock.

Bulletin 107—Automation (Heavy-Duty) Air Cylinder for 200 psi operation.

Bulletin 108—Automation (Heavy-Duty) Hydraulic Cylinder—for 1000 psi operation.

All O-M Cylinders are available in 1¼" to 8" bores with standard or heavy-duty rods. Complete line of mounts and interchangeable parts. Immediate delivery on most sizes. **MAIL COUPON TODAY.**

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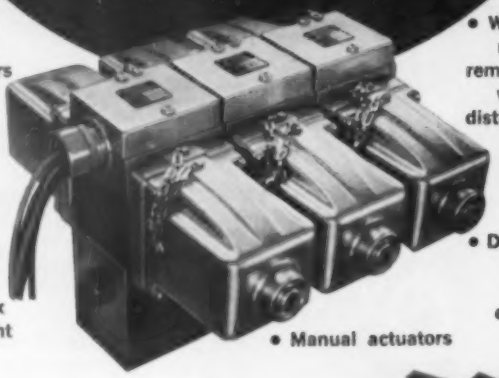
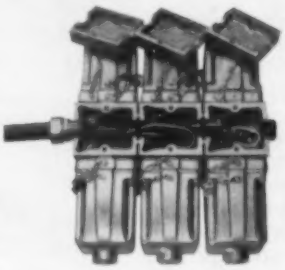
*NEW!

BECKETT HI-CYCLIC

3/8" DIRECT ACTING SOLENOID VALVE FOR MANIFOLD MOUNTING



- Compact—mounts on 2⅝" centers—up to 5 units on a manifold.
- When multiple mounted can remove an inner valve without disturbing wiring of other valves.
- Built-in electrical junction box—vapor-tight seal.
- Direct solenoid operated—industrial, constant duty type.
- Manual actuators



- With junction box covers off, valve design provides wide open conduit for easy installation of wiring. All wiring readily accessible.
- Solenoid and junction box covers chained to valve body.

TYPE:

⅜" capacity double or single solenoid, spring return — fast reaction for accurate control.

2, 3, or 4 way, 2 or 3 position.

7 spool types available to meet all requirements.

Furnished with standard equipment or to JIC standards.

MEDIA:

Air, vacuum and all conventional hydraulic fluids.

NFPA NATIONAL FLUID POWER ASSOCIATION MEMBER

WRITE TODAY FOR DETAILED INFORMATION

DISTRIBUTORS IN MAJOR CITIES COAST-TO-COAST AND CANADA

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981 W. LOCUST STREET, WILMINGTON, OHIO

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...Along the aisles

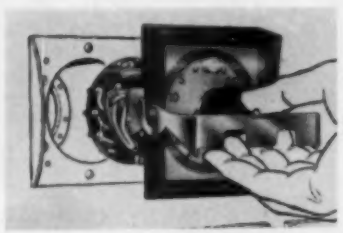
529 Cuno Engineering Corp.

You'll see . . . All metal, edge-type filters for positive filtration of fluids without flow interruption. Require no cartridge replacements. Handle large volumes of fluids at low pressures. Filter housing only 1/5 the size used by disposable filter cartridges. Removes contaminants from hydraulic fluids where uninterrupted flow must be maintained.

Circle **204** on Time-Saver Card

381 Eagle Signal Co.

You'll see . . . Integrally designed plug-in case. Flush mounting. Terminals and wiring information on rear of

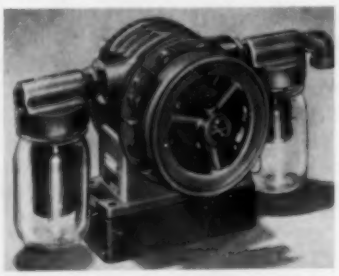


case. Timer may be removed and replaced from its case in 5 seconds. Contains four independent load contacts, two are instantaneous. Two are time delay relay contacts operating at the end of the time setting.

Circle **205** on Time-Saver Card

512 Gast Mfg. Co.

You'll see . . . Vacuum pumps with oil-free exhaust air. No grease or oil in pumping chamber. No hot oil vapor



or odor in exhaust. No lubrication required. Carbon vanes are self lubricating. Oil-less design reduces cost of maintenance and lubricants. No vibration, pounding or pulsation. V-belt drive for choice of speeds.

Circle **206** on Time-Saver Card

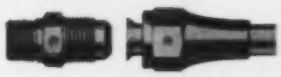
Continued on page 78

WEATHERHEAD

offers one source for all tube fitting needs... a complete line of flared, flareless or pipe...

TUBE FITTINGS of BRASS, CARBON or STAINLESS STEEL

BRASS FITTINGS



S.A.E. 45° FLARE
USED with copper, brass, aluminum, steel and plastic tubing. PRESSURE RATINGS up to 5000 p.s.i. **Sizes: ⅛" to ¾".** Also available in 37° heavy pattern brass. Listed by U.L.; approved by A.G.A. Meets specs of S.A.E. Hydraulic Tube Fittings Standards and A.S.A. and A.S.M.E. codes for instruments and control piping.

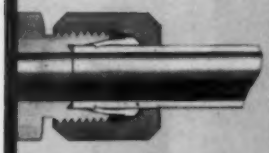
COMPRESSION
USED with copper, brass, aluminum and plastic tubing. PRESSURE RATINGS up to 2000 p.s.i. **Sizes: ⅛" to ¾".** Listed by U.L.; approved by A.G.A. Meets specs of S.A.E. Hydraulic Tube Fittings Standards and A.S.A. and A.S.M.E. codes for instruments and control piping.

SELF-ALIGN®
No flaring, soldering, welding—insert tube and tighten nut. USED with copper, brass, aluminum and plastic tubing. PRESSURE RATINGS up to 2000 p.s.i. **Sizes: ⅛" to ¾".**

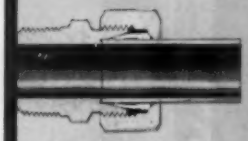
INVERTED FLARE
USED with copper, brass, aluminum, steel, Bundyweld and plastic tubing. PRESSURE RATINGS up to 3000 p.s.i. **Sizes: ⅛" to ¾".** Listed by U.L. Meets specs of S.A.E. Hydraulic Tube Fittings and A.S.A. and A.S.M.E. codes for instruments and control piping.

PIPE
USED with brass or steel pipe. PRESSURE RATING: up to 5000 p.s.i. **Sizes: to 2".** Meets specifications of S.A.E. TPHL Fittings Committee.

FORGED STEEL FITTINGS



"7000" SERIES ERMETO®
U.L. listed. Meets J.I.C. standards. S.A.E. approved "O" Ring boss design. Dryseal pipe thread. Needs no flaring. Available in either carbon or stainless steel. Carbon steel fittings have "Weathercoat" or cadmium-plate finish. PRESSURE RATINGS: up to 10,000 p.s.i. **Size Ranges—⅛" through 2".**

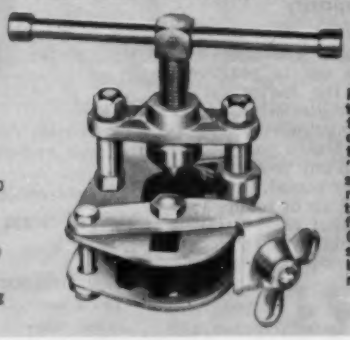


"8000" SERIES ERMETO®
Listed by U.L. for use with hazardous liquids, fuel equipment, refrigeration and gas; meets specs of S.A.E. and J.I.C. hydraulic tube fitting standards. Supplied as standard in cadmium-plate carbon steel and in stainless steel. Requires no flaring. PRESSURE RATINGS: up to 10,000 p.s.i. **Size Ranges—⅛" through 2".**

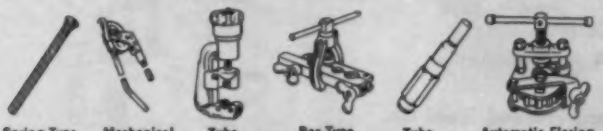
FLARE-TWIN—(2-pc. or 3-pc.)
37° FLARE STEEL TUBE FITTINGS
Listed by U.L., S.A.E. and J.I.C. approved. Used with J.I.C. and other soft steel tubing; also with copper, aluminum, and fully annealed stainless steel tubing. Meets S.A.E. standards for straight thread boss mounting. PRESSURE RATINGS up to 10,000 p.s.i. **Sizes: ⅛" through 2".**

FLARE-TWIN
Made in 3-piece and 2-piece assemblies. 2-piece type offers price advantage. "Weathercote" or cadmium-plate finish.

FAST! EASY! ACCURATE TUBE WORKING TOOLS



New rotary flaring tool for perfect tube flaring. Fast . . . one piece construction. Easier . . . "Dial - Matic" tube size selection. Accurate...tube stop automatically controls flaring diameter. Compact . . . easy to store. Available with burnishing attachment.



THE WEATHERHEAD COMPANY

FORT WAYNE DIVISION • Dept. AH-9, 128 West Washington Blvd.
Fort Wayne, Indiana

Circle **153** on Time-Saver Card

. . . precise stainless steel Flow Metering Valve with Vernier adjustment and metal-to-metal lap seat . . . removable for remote positioning

. . . heavy one-piece nose and end cap construction, complete with O-ring seals

. . . spring loaded balance cylinder

. . . precision engineered piston check valve

. . . heavy duty stainless steel shaft

. . . large cylinder bore diameter and reservoir capacity

Direction Valve

Flow Valve

Meter Valve

Here is a checking unit you can use to positively control the movement of any type air, oil or water operated cylinder. POW-R-TROL Units can be installed in any position; vertical, horizontal, diagonal. Optional air or solenoid actuated pilot valves provide stop checking, skip checking or stop-skip combinations.

Available with working pressures up to 3000 psi, strokes up to 20 inches, and with forward, reverse or double action.

Write for complete details.

POKORNY POW-R-TROL PRODUCTS Inc.
10643 Memphis Road • Cleveland 9, Ohio

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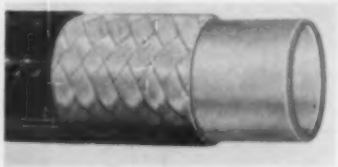
450 Imperial Brass Mfg Co.

You'll see . . . Plastic hose for high pressure hydraulic applications. Polyamide inner tube has high tensile strength polyester braid reinforcement. Abrasion resistant polyamide cover. Will withstand burst pressures comparable to SAE 100-R1 wire braid hose. Superior flex-impulse strength and resistance to abrasion. Non-aging, long



lengths available. For non-flamable hydraulic fluids to 200 F, and flamable fluids to 225 F. Available with reuseable and permanently attached coupings.

Circle **207** on Time-Saver Card

253 Marvel Engineering Co.

You'll see . . . A line type filter for installation on suction or return lines. For hydraulic oil and fire-resistant fluids. Pressures to 250 psi. Temperatures to 300 F. Made in 10, 20, 30, 50 and 75 gpm sizes. Monel wire cloth

mesh sizes from 30 to 200. With or without by-pass valve. Connections for vacuum and/or pressure gage. Easy to disassemble and clean.

Circle **208** on Time-Saver Card

232 Standard Pressed Steel Co.

You'll see . . . Projected photoelastic stress patterns made by passing polarized light through models of screw threads. Screw thread in form of truncated V has high stress concentrations in corners. Rounded form root has smoothly flowing stress lines.

Circle **209** on Time-Saver Card

405 Purolator Products Inc.

You'll see . . . Filters capable of removing sub-micronic particles from lubricating and hydraulic systems. Refill type oil, air, and fuel filters. Metal-edge industrial filters for in-plant and original equipment use. Special filters (size of a man's thumbnail) protect an aviation hydraulic system.

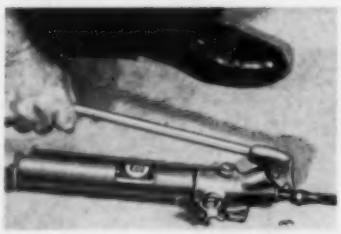
Circle **218** on Time-Saver Card

220 Ross Operating Valve Co.

You'll see . . . A lock out and exhaust valve that can be padlocked in closed position to cut off air supply to machine or portions of a circuit. Safe during repair or shutdown periods. Air downstream of locked valve exhausts. Detented in open position. Low pressure drop. Lightweight, aluminum valve has only one moving part. Available in four sizes, ⅜" to 1" pipe

Circle **210** on Time-Saver Card

435 Owatonna Tool Co.

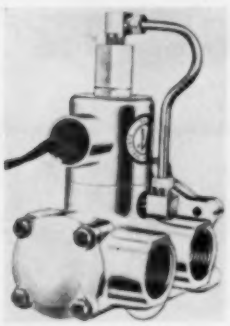


You'll see . . . A compact hydraulic hand pump. Develops 8,650 psi. Pump is 14-5/16" long. Oil capacity is 13.5 cu. in. Piston area is .110 sq. in. Diameter is ⅜". Displaces .0621 cu. in. Hose outlet is ¼" NPT.

Circle **211** on Time-Saver Card

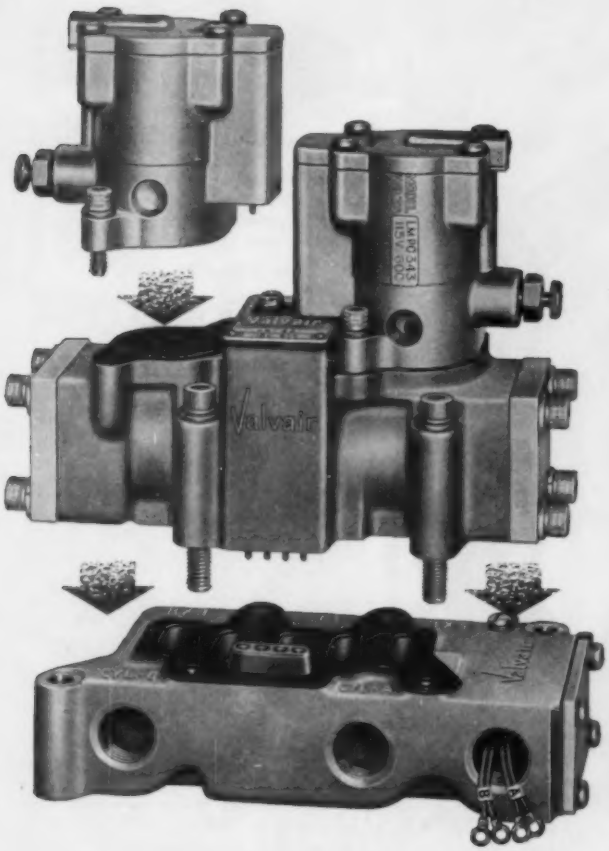
212, 214 Skinner Electric Valve Div. Skinner Chuck Co.

You'll see . . . A 3-way ⅜" orifice high-flow, solenoid valve. For air, wa-



ter, and oil. Valve is light and compact. Mounts in any position. Operates on a pressure differential of 10 to 150 psi.

Continued on page 80



VALVAIR® ½" NPT PLUG-IN VALVES

MODEL PD-441 shown. 4-way single or double pilot-operated types, for sub-base or manifold mounting. Aluminum and stainless steel components assure multi-million cycle dependability. Interchangeable pilots, with coils guaranteed against burn-out for life of valve, fit any plug-in Speed King. Coils for ac or dc, any voltage . . . 35 — 200 psi range . . . integral junction box . . . optional manual over-ride, common or separate exhaust ports, sub-base connected external pilot supply . . . ¾ in. exhaust ports, ½ or ¾ in. inlet and cylinder ports . . . valve meets JIC standards.

Based on the service-proved design principle of the Speed King ¼ in. plug-in Valvair's ½ - ¾ in. plug-in valve series provides plug-in convenience and versatility to a wider range of control valve applications.

Electrical and pneumatic circuits are completed automatically when valve and pilot are plugged in . . . bolted down. The result — cost-cutting reduction of original installation and maintenance time. All power connections are made permanently in sub-base or manifold . . . there's no need to disturb piping or wiring for quick in-service maintenance.

What's more, advanced design shortens stroke . . . speeds response. Separate coded (4-wire) circuits on double solenoid models meet JIC requirements. Flow area through valve and sub-base equals that of full ½ in. pipe.

Whether your control valve applications are on the drawing board or now in service, it'll pay you to investigate the advantages of Valvair plug-in design. A call to your near-by Valvair field office will bring prompt application engineering recommendations.

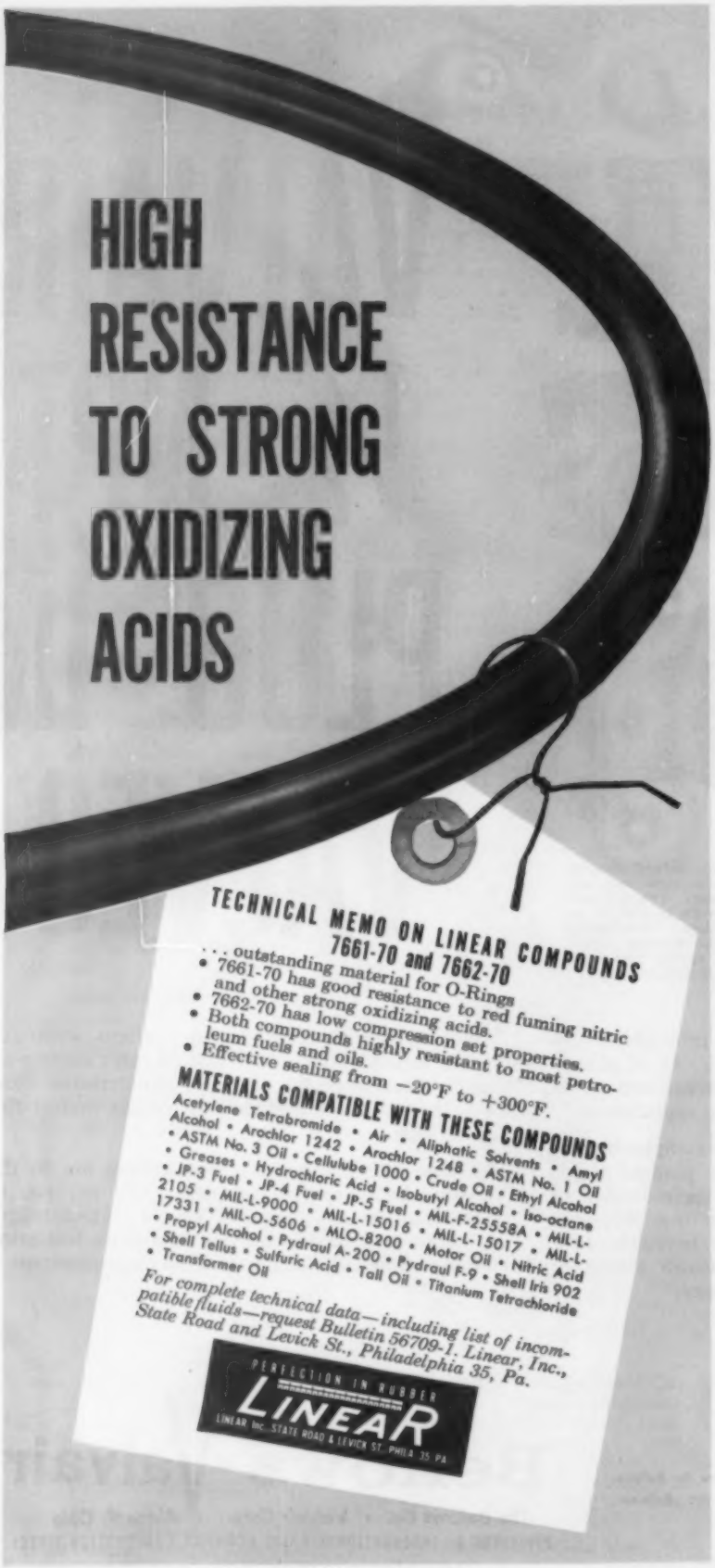
For more information, write for Bulletin SPL. Address Dept. AH-960, Bellows-Valvair, Akron 9, Ohio

Bellows-Valvair

The Bellows Co. • Valvair Corp. Akron 9, Ohio

DIVISIONS OF INTERNATIONAL BASIC ECONOMY CORPORATION (IBEC)

B098-3


HIGH
RESISTANCE
TO STRONG
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ACIDS
TECHNICAL MEMO ON LINEAR COMPOUNDS
7661-70 and 7662-70
. . . outstanding material for O-Rings
• 7661-70 has good resistance to red fuming nitric and other strong oxidizing acids.
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Acetylene Tetrabromide • Air • Aliphatic Solvents • Amyl Alcohol • Arochlor 1242 • Arochlor 1248 • ASTM No. 1 Oil • ASTM No. 3 Oil • Cellulube 1000 • Crude Oil • Ethyl Alcohol • Greases • Hydrochloric Acid • Isobutyl Alcohol • Iso-octane • JP-3 Fuel • JP-4 Fuel • JP-5 Fuel • MIL-F-25558A • MIL-L-2105 • MIL-L-9000 • MIL-L-15016 • MIL-L-15017 • MIL-L-17331 • MIL-O-5606 • MLO-8200 • Motor Oil • Nitric Acid • Propyl Alcohol • Pydraul A-200 • Pydraul F-9 • Shell Iris 902 • Shell Tellus • Sulfuric Acid • Tall Oil • Titanium Tetrachloride • Transformer Oil
For complete technical data—including list of incompatible fluids—request Bulletin 56709-1. Linear, Inc., State Road and Levick St., Philadelphia 35, Pa.
PERFECTION IN RUBBER
LINEAR
LINEAR INC. STATE ROAD & LEVICK ST. PHILA. 35 PA.

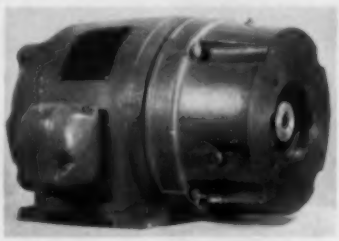
...Along the aisles

Body is forged brass. Internal parts are stainless steel and brass. NO, NC, and directional control. Wide range of voltages and frequencies.

Circle **212** on Time-Saver Card

159, 161 U. S. Electrical Motors, Inc.

You'll see . . . A close-coupled hydraulic pump motor with corrosion resistant cast iron frame. Mounting bracket eliminates mounting base and complicated adaptors. Concentric mounting is assured with normalized castings that prevent warping. Cast iron frame provides strength and rigidity to support hydraulic pump and motor. Single and double end models available to fit all standard hydraulic pumps. ¾ to 50 hp.



Circle **213** on Time-Saver Card

107 Vickers Inc.

You'll see . . . A traverse and feed panel providing a compact and precise control unit. For drilling, boring, reaming, and milling. Interchangeable with previous panels. Incorporates solenoid-controlled directional movement. Cam actuated coarse and fine feed rates for maximum tool efficiency. Mechanically actuated portion of panel is separated from solenoid controlled directional unit. Electrical actuating control can be remote.

Circle **214** on Time-Saver Card

Continued on page 82

Circle **85** on Time-Saver Card

Circle **136** →

WEAR RESISTANT
THOMSON

60 Case

AVOID the HIGH COST and difficulty of fabricating long, hard & straight parts by conventional methods!

hardened and ground

SHAFTS, ROLLS, GUIDE RODS and other long-round parts

ELIMINATE WEAR and REDUCE COST

60 Case is the result of over 15 years of experimental work and production experience with hardened and ground shafts which are a requirement for BALL BUSHINGS, the Linear Ball Bearing manufactured by Thomson Industries, Inc.

The special techniques and equipment that have been developed enable high production rates and low handling costs. This permits big savings over conventional methods which are plagued with erratic warpage, straightening and resultant grinding problems. Finished *60 Case* parts frequently cost less than the scrap losses that result from conventional methods.

60 Case material has a surface hardness close to 60 on the Rockwell C scale which is essential to resist wear.

Long lengths of material ranging in diameter from ¼" to 4" are stocked to enable prompt shipment of *60 Case* parts, with or without special machining. *Write for literature and name of your local representative.*

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ADVANTAGES of *60 Case*

- COST REDUCTION
- HARD BEARING SURFACE
- NICK-& DENT-PROOF
- ACCURATE DIAMETERS
- GROUND FINISH
- STRAIGHT PARTS
- DELIVERY FROM STOCK
- ADDED STRENGTH
- UNIFORM HIGH QUALITY

TYPICAL *60 Case* PARTS

GUIDE RODS • SHAFTING • ROLLS • TRAVERSE RAILS
PISTON RODS • ARBORS • LEADER PINS • TIE RODS
KING PINS • AXLES • CONTROL RODS • GUIDE POSTS
MANDRELS • BEARING ROLLERS • SPINDLES

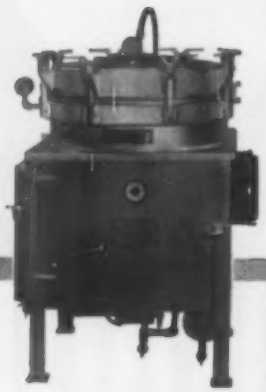
THOMSON INDUSTRIES Inc.
Dept. C-4, Manhasset, New York

PARTS HARDENED to 60 C...
increase life...reduce cost!

LOWER YOUR VACUUM PUMP MAINTENANCE COSTS

with a

HILCO OIL RECLAIMER



HILCO Oil Reclaimer purifies vacuum pump oil by continuous recirculation, either on a full-flow or by-pass basis, or intermittently on a batch basis, depending on the requirements and physical layout of your plant.

HILCO OIL RECLAIMER SYSTEMS are the finest available for VACUUM PUMP users . . .

A simple, economical and efficient method of restoring contaminated lubricating and sealing oil to the full value of new oil. A HILCO will produce and maintain oil free of all solids, sludge, acid, moisture, solvents, and dissolved gases and it will restore viscosity, dielectric strength and other specifications to new oil value. HILCO oil reclaimers are in wide use for purification of vacuum pump oil in many manufacturing operations.

• SPECIAL FEATURES •

THERE'S A HILCO FOR EVERY OIL PURIFICATION JOB . . .

- CONTINUOUS, ALL ELECTRIC, AUTOMATIC OPERATION
- LOW OPERATING TEMPERATURE
- VACUUM PROCESSING
- LOWERS VACUUM PROCESSING COSTS

THE HILLIARD Corporation

FOR COMPLETE DETAILS, WRITE FOR BULLETIN R-160.

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UPTON-BRADEEN-JAMES, LTD.

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Circle **69** on Time-Saver Card

. . . Along the aisles

355 Watts Regulator Co.

You'll see . . . An injection oiler that provides direct oiling to low volume-short stroke air cylinders. Installed in

pressure line between control valve and cylinder. Oil is delivered through a capillary tube. Pressures up to 250 psi. Maximum temperature 300 F. Delivery 0 to 100 drops per min.

Circle **215** on Time-Saver Card

301 Westinghouse Air Brake Co., Industrial Products Div.

You'll see . . . How fluid power lets you drive a nail with a feather. Multi-position air cylinders. Seven different

types of directional air valves. Air circuits with safety interlock. Sequence operation and other controls. An eight penny nail is driven into a wooden block by the touch of a feather. Selection of nail, positioning of block, and driving of nail is done pneumatically.

Circle **216** on Time-Saver Card

421 Wilton Tool Manufacturing

You see . . . An air-hydraulic powered machine vise equipped with jaw adapters designed for specific work pieces. Jaws can be shifted from operation to operation.

Circle **217** on Time-Saver Card

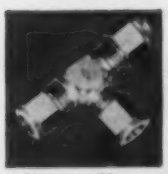
IMPERIAL
Engineering and Data File

IMPERIAL HI-SEAL AT A GLANCE . . .
. . . leakproof butt joints
shortest tube bends
saves space
holds pressures to 75,000 psi
temperatures to 1400 degrees
withstands extreme vibration

THE MOST VERSATILE TUBE FITTING YOU CAN USE!

Now it's official. U. S. Patent No. 2,934,362 — just issued — recognizes seven claims for the only true butt joint tube fitting on the market. Imperial Hi-Seal is available in a variety of types that meet unusual pressure, temperature, vacuum and vibration conditions. And Hi-Seal allows bends closer to the fitting, making possible more compactness than ever before — saves space, saves tubing. All this *plus* make-and-break convenience.

Here are some of the variations that make Hi-Seal so versatile:



FILTER TEE. A highly efficient, easily installed blow-off type filter with sintered wire element. Standard filtration rating of 5 microns filters dust and impurities from gases for accurate instrument readings. For use in chromatograph analyzers and other gas analyzers, separation of water particles from oil and for protection of air activated instruments.

BRAZE-SEAL. Withstands pressures and temperatures that previously required a welded joint. Special alloy brazing rings for temperatures as high as 1400°F.

THERMOCOUPLE. Provides the advantages of higher pressures and temperatures, plus the positive make-up obtainable with Hi-Seal fittings. Also available with Teflon sleeve to permit readjustment to any depth.

DURA-TITE. The most effective port seal for tube fittings. No seeping — even at pressures up to 20,000 psi. Withstands higher temperatures than O-Rings.

Hi-Seal fittings are furnished in steel, stainless, brass and aluminum as stock items — also titanium, tantalum, Monel, Penton, Teflon and other metals and plastics to order. Available in a complete range of styles and sizes.

Hi-Seal offers further proof that Imperial is the company *with a habit of leadership.*

IT'S IN THE BOOK
Comprehensive data is furnished in the new Hi-Seal Catalog No. 3108 — the catalog that serves as an engineer's handbook as well. Send for your copy today.

THE IMPERIAL BRASS MFG. CO.
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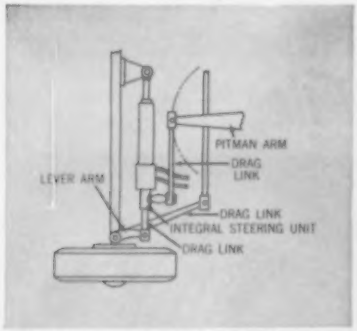
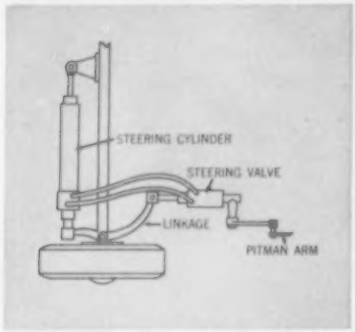
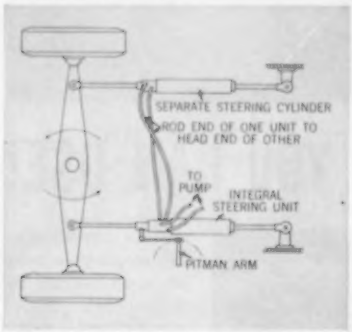


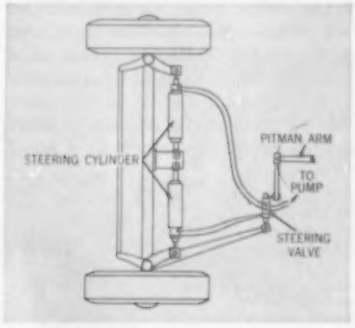
INTEGRAL LINKAGE system combines servo valve and steering cylinder with rod end fastened to frame and valve end to drag link.



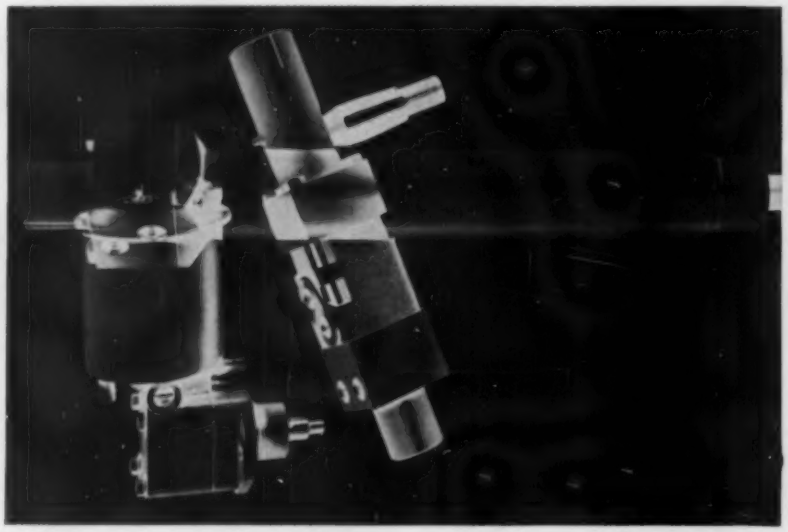
REMOTE LINKAGE system has separate servo valve and cylinder. Servo is mounted at most convenient point with cylinder located for maximum thrust.



COMBINED INTEGRAL-REMOTE system servo valve controls both cylinders. When integral unit (bottom) extends, remote unit (top) retracts.



REMOTE DUAL system uses one remote servo valve, offers best possible thrust conditions plus considerable installation flexibility.



FOR AXLE LOADINGS 1500—128,000 LBS.

New VICKERS power steering systems use standard units, offer custom performance

Performance benefits normally associated with custom designs plus the economy of standard, production-built components are combined in new Vickers power steering systems. The cylinder, servo valve, and pump—key elements in the power steering system—are always perfectly matched to system needs because Vickers builds the *complete system*.

Either remote or integral systems can be provided for the complete range of axle loadings from 1,500 to 128,000 lbs. All vehicles use the same servo valve—holding engineering and installation time to a minimum and reducing inventory requirements for manufacturers building several sizes or types of equipment.

Operating Economy—Systems are designed for high pressure operation (to 2000 psi) permitting smaller pumps, lines, reservoirs, valves and cylinders to be used. Further economy results because each basic size of steering unit is capable of a wide range of axle loadings. This permits some manufacturers to use a single size of steering unit for their complete line of vehicles. For example, in a single cylinder installation, the Model SC-26 cylinder can be used for any axle loading from 16,000 to 64,000 lbs.

Further economy over the life of the system results from the minimum number of moving parts required by this design and from its rugged construction. All cylinders are double walled to eliminate the common hazard of functional damage to cylinder walls from flying debris. Exclusive design vane pumps last longer, permit easy cold weather starting because pumping doesn't begin until after engine fires and comes up to speed.

Complete Responsibility – Both the equipment builder and ultimate user benefit because Vickers designs and builds all system components. In addition, a staff of power steering specialists is available to work with customers on specific development and application problems.

When equipment is being built for the export market, worldwide stocks and complete interchangeability of all parts made in Vickers plants throughout the free world offer added benefits.

More Data – Design advantages, dimensions, ratings, and other data are available in Bulletin titled "New Complete Power Steering Systems." Write for this 20 page Bulletin M5110.

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Telescopic cylinders dump this 35-ton truck which dwarfs the author.

Beginning in this issue

MOBILE EQUIPMENT HYDRAULICS...a design primer

● By **RUSSELL W. HENKE,**
Director of Research, Racine Hydraulics & Machinery Inc., Racine, Wisc.

PART 1

AS TECHNOLOGIES GROW, they become more specialized. This is the history of fluid power which now divides generally into industrial, mobile equipment, and aircraft applications. Because requirements in these fields are very different, components are

designed for different characteristics, and are seldom used outside their intended field.

Basically, however, the same principles apply to hydraulic systems—pressure times area still equals force—and the essential components—pump, valve, actuator, and plumbing are common to all hydraulic systems.

In contrast to many industrial applications where most of the hydraulics is packaged in a central power unit, a mobile equipment system is usually designed on a component basis, because of limited space on a vehicle. Therefore, it has not been uncommon to have the pump furnished by one manufacturer, the valves by another, and the actuator by still a third. More recently, the trend has been toward manufacturers offering a line of matched components.

PUMP DRIVES

In industrial applications, pumps are almost always driven by an induction motor. In mobile equipment the pump must be driven by the vehicle's engine or an auxiliary engine. The designer has several choices in mounting the pump if he wants to drive it from the vehicle engine.

1. Side-mounted power-take-off on transmission.—This limits pump operation because the pump can run when only the vehicle is not driving. An inexpensive pump can be used in this arrangement because duty is extremely intermittent. A typical application of this design is a hoist on a dump truck.

2. Front-end power-take-off.—The pump is driven off the front end of the crankshaft. This has the advantage of being able to drive the pump while the vehicle is driving. The pump should have continuous duty capability and consequently will be more expensive than the intermittent duty pump. Full engine power can be delivered to the pump if the arrangement is properly designed.

3. Split power-take-off—This is mounted between the flywheel and clutch and permits continuous pump operation while the vehicle is operating.

4. Accessory drive—Many vericle engines have built-in accessory drives which will mount a pump with a standard SAE splined shaft and flange mounting. This design permits continuous pump operation.

5. Fan-belt driven—This design is usually restricted to small accessory applications, such as a jeep, snow plow, or light agricultural implements.

6. Engine bell housing—For full hydraulic power transmission, the pump could be mounted on an adapter to the housing to use full engine power. This arrangement would be used for a hydrostatic transmission.

7. Auxiliary engine drive—A separate engine may be installed to drive the pump.

Continued on page 88

WHERE HYDRAULICS IS USED ON MOBILE EQUIPMENT

Earth Moving Equipment	Construction Equipment	Materials Handling	Miscellaneous	Agricultural Equipment
Dump Trucks	Pavers	Fork Lift Trucks	Mining Machines	Tillers
Bull Dozers	Concrete Mixing Plants	Conveyors	Railway Maintenance	Combines
Graders	Rollers & Compactors	Cranes	Logging	Plows
Scrapers	Vibrators	Tractors	Oil Well Drilling	Discs
Front-End Loaders	Screeds	Missile Handling	Aircraft & Missile	Spreaders
Shovels	Bituminous Sprayers	Refuse Collectors	Ground Support	Planters
Back-Hoes	Asphalt Spreaders	Aerial Ladders	Marine	
Trenchers	Chip Spreaders	Hi-Lift Platforms	Forge Manipulators	
Rippers	Hammers			
Pushers	Transit Mixers			
Tractors	Crushers			
Drills	Concrete Spreaders			

DRILLING MACHINE for underground mining. An air motor drives the hydraulic pump which supplies fluid to the positioning cylinders on the drill booms. Air motors drive the drills. *Gardner-Denver Co.*

HYDRAULICALLY ACTUATED HAMMER used for breaking up concrete. A cylinder is mounted vertically beside the tower and raises a heavy weight through a cable rig. Dumping oil out of the cylinder releases the weight. *Ottawa Steel Co.*

AERIAL MAINTENANCE VEHICLE eliminates hydraulic lines across joints. Cylinders actuate upper and lower arms through cables. Aircraft type controls are mounted on the support shaft of one bucket and do not interfere with arm movements. Bucket raises 36′ 10″, extends 31′ 4″ horizontally, and bends 8′ 8″ below ground level. Mast rotates continuously in either direction. *J. H. Holan Corp.*

Most valves used in mobile equipment are for directional control. Fewer flow control and pressure control valves are used than in industrial applications.

VALVE DESIGN

Depending upon the complexity of the circuit, valves range from a single, lever-operated, spool type mounted within reach of the operator, to a relatively complex, solenoid-controlled, pilot-operated unit. Relief valves are frequently built into the valve housing or the pump housing. Check valves may be built in too.

VALVE ACTUATION

In dozers, graders, and heavy tractors, valves are usually mounted within the operator's reach so he can actuate them manually.

In dump trucks, refuse units, and similar truck installations, the valve is usually away from the cab, perhaps on the reservoir, and is remotely operated from the cab by remote lever or flexible control.

In cranes and shovels, valves may be solenoid actuated with the control switch panel-mounted near the operator, or at a centralized control center.

RESERVOIRS

Industrial practice generally calls for a reservoir capacity of from 2 to 2½ times pump capacity in gpm. In mobile equipment this usually isn't possible because of space limitations. For example, a pump delivering 70 gpm would require a tank capacity of 140 to 175 gallons which is far too big for most machines. Mobile equipment designers generally try for a reservoir capacity of at least 150% of pump capacity in gpm.

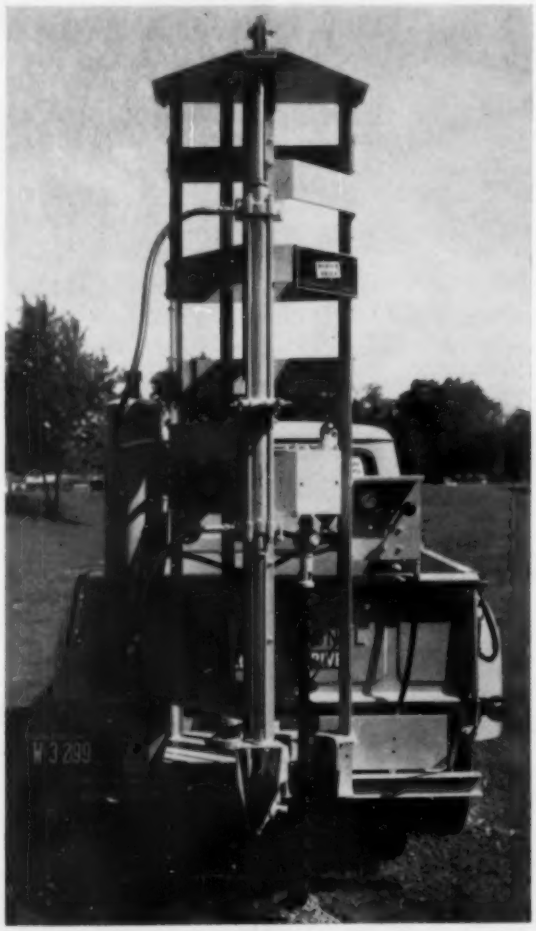
Reservoirs can't be as standardized as for industrial equipment. Because of limited space, they must be designed to make the most of what space is available. This sometimes results in odd shaped tanks compared to typical industrial reservoirs which conform to JIC standards.

Using part of the vehicle structure as a reservoir is not uncommon. For example, a cross member made of pipe or tubing, instead of channel, might be used as the tank.

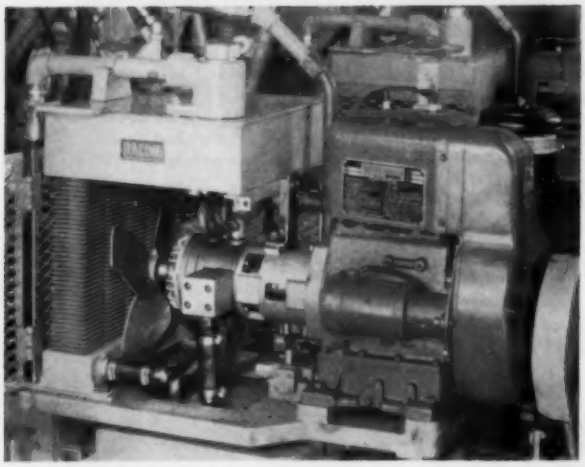
The tank's required capacity will, of course, affect its design and location. Sometimes a compromise must be made between *desired* capacity and available space. The tank can sometimes be made smaller by sizing hydraulic lines and valves carefully to avoid turbulent flow and heating. But sometimes an oil cooler or heat exchanger may be needed. Baffling to produce maximum oil circulation aids cooling.

Reservoir mounting must be carefully designed. Deflections of the vehicle structure must not be transmitted to the tank, unless it is designed as part of the structure itself. Mobile equipment tanks are frequently mounted on springs which take up vehicle structural deflections instead of transmitting them to the tank.

Continued on page 90

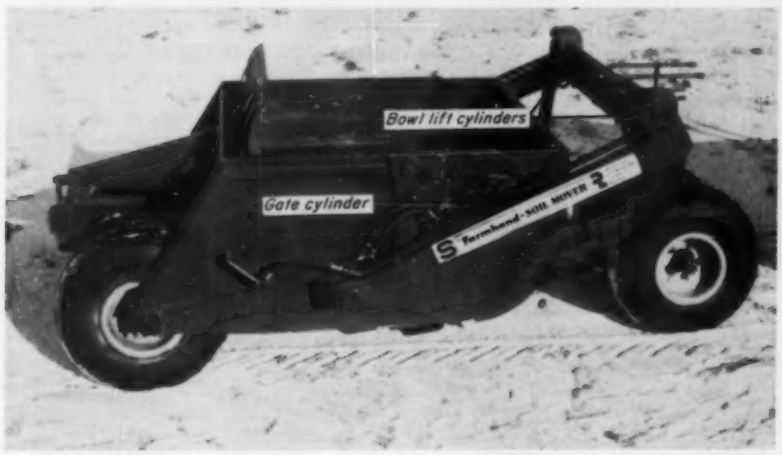


EARTH BORING MACHINE installed on a truck. The auger is fed by a hydraulic cylinder mechanism. Pump is driven from transfer case and is synchronized with drill. Engaging drill power take-off also engages pump. *Mobile Drilling, Inc.*



BALLAST TAMPING MACHINE for railroad maintenance has hydraulic pumps driven by auxiliary engines (see below). A horizontal cylinder below the machine clamps the rails. Two large jack cylinders, one on each side, raise the entire machine and section of rails off the ties. Two heads, one on each side perform actual tamping operation. These have a central ram for raising and lowering. Four tamping cylinders are positioned by four small cylinders and parallel linkages. Oil is supplied to the heads from an accumulator charged by engine-driven pumps. A 4-way shuttle valve built into the casting transmits one cu. in. of oil alternately 1160 times per minute to the top and bottom of the tamping cylinders. The valve spool is shifted by an alternating pilot flow delivered to the ends of the spool by a rotary valve. The rotary valve is driven by the engine. *Racine Hydraulics & Machinery, Inc.*

BACK-HOE IS AN EXAMPLE OF COMPLEX MOTION with cylinders. Three cylinders are mounted on the arm and bucket. The bucket cylinder controls bucket angle for digging, loading, transporting, and dumping. The upper arm cylinder controls upper arm position for reaching, loading, transport, and discharge. Lower arm cylinder controls the lower arm for reaching, elevation. Two cylinders swing the arms horizontally. Two cylinder-operated stabilizing outriggers are behind the rear wheels. Bucket loader is installed on front of tractor. *Shawnee Mfg. Co.*



TOWED SCRAPER has action similar to larger, self-propelled scrapers. Hydraulic power is supplied by the towing tractor. A ram between the two rear wheels, operates a pusher which discharges earth from the bowl during spreading operations. Control is by lever-operated, 4-way valves mounted on the towing tractor. *The Farmhand Co.*

Avoiding contamination is a major consideration in designing mobile applications. Filters, breather caps, strainers, and magnetic plugs are all helpful, but the big problem is maintenance. Getting operating personnel to change filters is a problem no designer can face directly. He can only make maintenance easy, then hope it's done.

ACTUATORS

The cylinder's job in mobile equipment includes hoisting, dozer blade tilting, agricultural attachment positioning, load buck actuation, back hoe manipulation, and many others.

Mobile equipment cylinders are generally more rugged than industrial cylinders. In many applications the mobile cylinder is actually part of the vehicle structure as well as an actuator. It must be able to take terrific shock loads, like the impact of a dozer blade on a buried rock.

Mobile equipment cylinders are designed for operating conditions far beyond the capabilities of most industrial cylinders. Dirt and corrosion are the two big problems, plus the added one of greater vulnerability to physical damage.

For the past 15 years, mobile equipment components have been rated at 1000 psi or higher. In the last decade, mobile equipment systems have operated at 1500-1800 psi with standard gear or vane pumps. Pressure loading of gear pumps has raised pressures to 2500 psi, and recent developments in piston pumps has pushed pressures to 3000 and 5000-6000 psi levels. 10,000 psi components are available but have had only limited application.

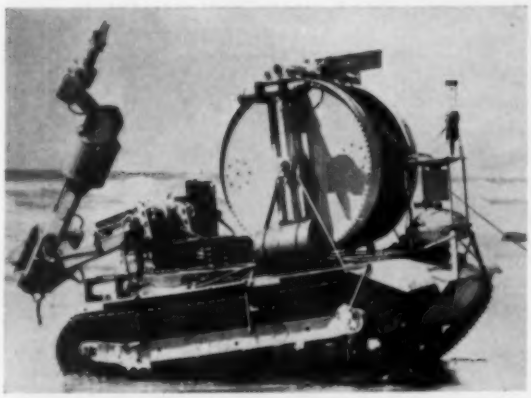
Fluid motors and rotary actuators are becoming more popular as actuators in the mobile field. Fluid motors are being used in hydrostatic transmissions in mining machines, missile ground support equipment, fork lift trucks, and farm tractors. And still more applications are in the works.

WHAT DOES IT COST?

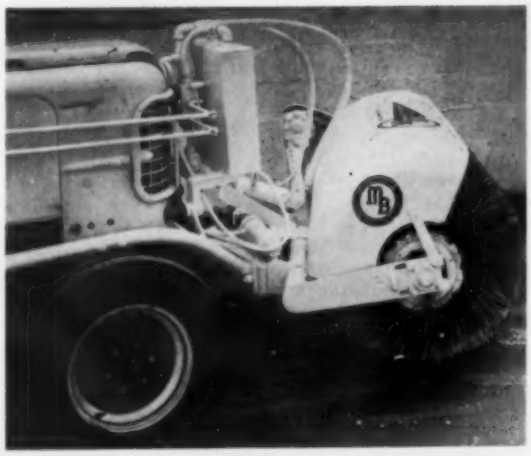
Mobile components are purchased more on the basis of cost than industrial components. One reason for this is the shorter life of mobile equipment compared to industrial machines. Cost of hoses, fittings, and other plumbing components is generally a bigger percentage of total cost than on a comparable industrial installation because of larger sizes required, higher pressures, and piping difficulties which require use of more hose than tubing or pipe.

Pumps vary from about $1.50 to $2.00 per hp for intermittent duty; $7.50 and $8.00 per hp for the 5000-psi to 6000-psi piston pumps.

Many mobile equipment systems require higher pump volume for a given cylinder size than their industrial counterparts. We think in terms of ¾", 1½", 2" valves in mobile systems rather than ⅜" and up. But size-for-size, a mobile valve costs less, though it is frequently more rugged. ▼▼▼



UNDERWATER PROBER developed for Navy ocean exploration has a hydraulic hand designed by General Mills that can reach out 15 feet to pick up samples from the ocean floor. The vehicle is remotely controlled from the shore using closed-circuit television. *University of California.*

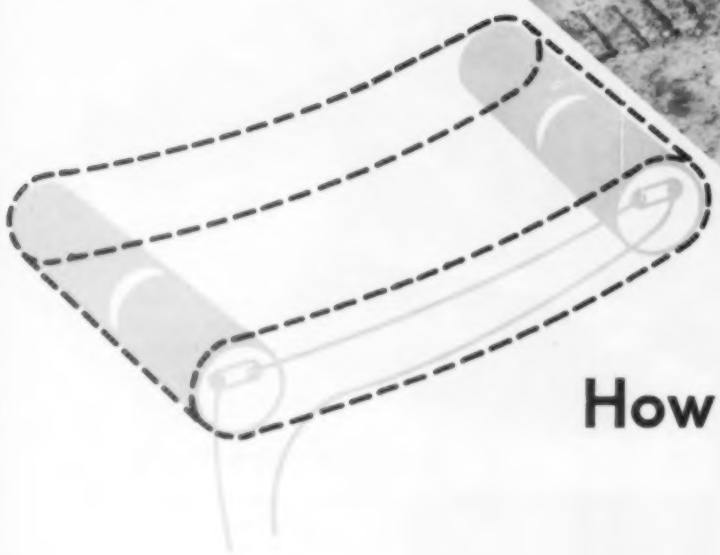


AN ALL-HYDRAULIC STREET SWEEPER has power furnished either by the tractor's pump or a pump mounted on a power-take-off on the rear of the tractor. Hydraulic motor is at the far end of the broom and drives through a chain reduction. Top cylinder raises and lowers the broom. Lower cylinder controls the broom angle. Reservoir and control valve are mounted on the front of the tractor. The drive requires about 15 hp at 1000 psi. *M-B Corporation.*

MATERIALS HANDLING EQUIPMENT in the construction industry. This is a special tractor which mounts a high lift, pallet-handler. One pair of long stroke rams controls elevation of the lift arms. A third, shorter stroke ram at the fork end gives finer vertical positioning at the end. A horizontal ram gives push-off control by extending the fork carriage from the lift arms. *American Road Equipment Co.*

PULPWOOD LOADER AND HANDLER mounted on a crawler tractor. Boom is pivoted at its lower end and in the middle like an arm and hand. Individual cylinders control each motion independently so that the claw can actually pick up loads below the level of the tractor. Either a horizontal ram or rotary actuator swings the boom. Cylinders operate the claw to grip or release the load. 4-way valves at operator's seat control the loader. Pump is driven by the tractor engine. Front-end loader is also mounted on the tractor. *E. Gafner Automotive & Machine Co.*

RAM LIFTS ROTARY TILLER off the ground for transport, and also adjusts depth of tiller cut. Oil is supplied from tractor hydraulic system and control is by a lever-operated, 4-way valve. Maximum system pressure is 1000 psi. *American Marietta Construction Machinery Div.*

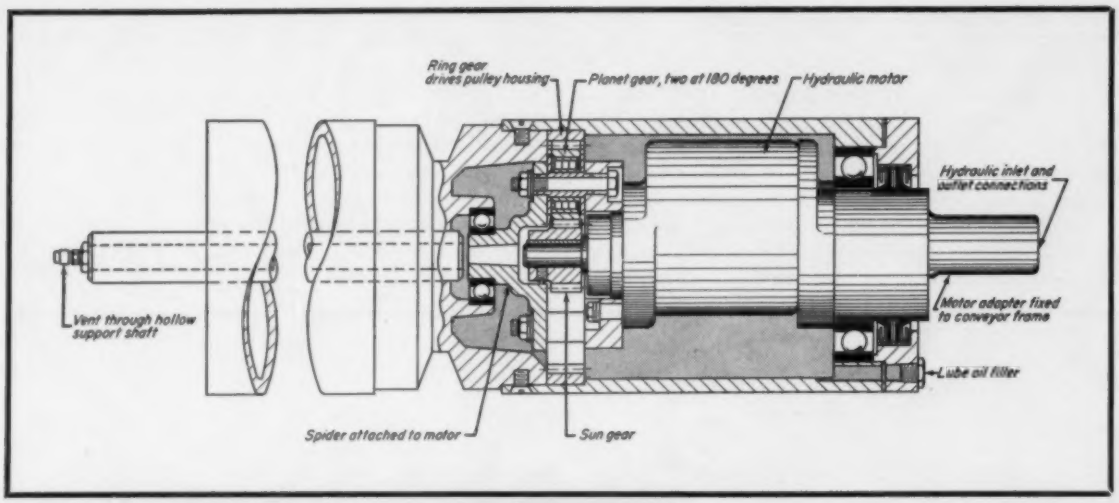


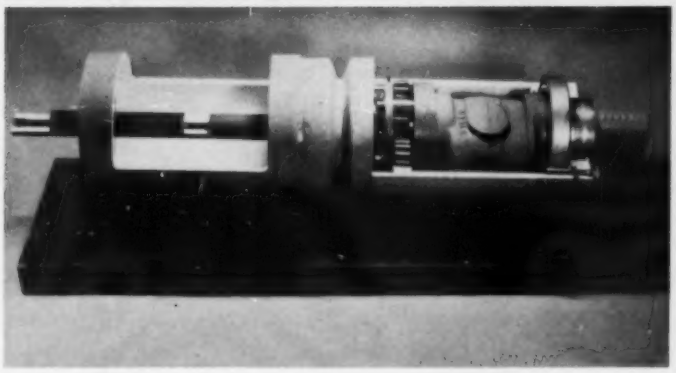
How we designed fluid

● By **FRED R. WILHELM**
and **HENRY L. MEYER**
Design Engineers
The Cleveland Trencher Co.
Cleveland, Ohio

A GEAR motor built into each end pulley of this trencher's conveyor makes a compact, well protected drive. Many trenchers still use a combination of chains, sprockets, and gear reduction units. Though some have gone to hydraulically driven conveyors, this is the first to eliminate these mechanical power transmission components. Each motor drives through a double planetary gear set with a reduction of 45:13 giving conveyor speeds from 200 fpm to 1000 fpm. The pulley motors are connected in series to make sure they rotate at the same speed regardless of how the load divides.

Hydraulic power is supplied by a variable volume, axial piston type pump driven off a power take-off. It supplies the variable speed conveyor and a cylinder which shifts the conveyor to de-


Ring gear drives pulley housing
Planet gear, two at 180 degrees
Hydraulic motor
Hydraulic inlet and outlet connections
Motor adapter fixed to conveyor frame
Lube oil filler
Vent through hollow support shaft
Spider attached to motor
Sun gear



OIL IS SUPPLIED to the motors through special steel adapters bolted to the rear of the motor assemblies. The two gear assemblies are lubricated by oil carried by the ring gear and pumped through holes in the planets, as planet and ring gears mesh. The gear motor's face bearing is not externally sealed and is lubricated by the lateral pumping action of the sun and planet gears.

PULLEY ITSELF BECOMES THE GEAR CASE as the fluid motor drives through planetary gearing. An extreme pressure lubricant is used in the pulley for good service life on bearings and gears. When the pulley is turning, the oil forms a hollow cylinder around the inside of the cylinder. The hollow support shaft vents this area.

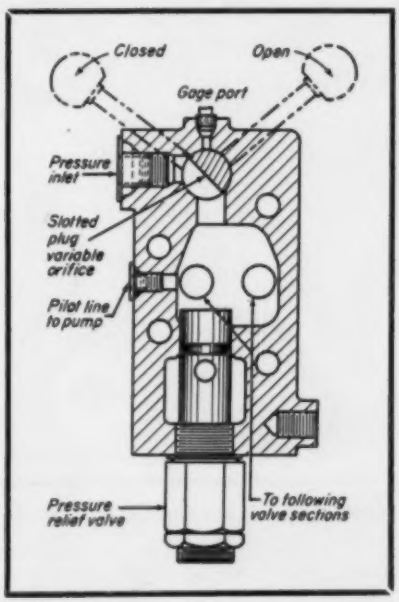
OIL FLOW RATE supplied by the variable volume, piston pump is regulated by a slotted plug type, flow control valve. The valve is mounted with the directional valve bank.

motors into our machine

liver dirt to either side of the trencher. It also supplies the crumbing shoe cylinder which raises and lowers a shoe that rides in the trench picking up dirt which the buckets miss. These three functions can be supplied by the same pump because they rarely occur together.

Oil flow rate from the variable volume pump is regulated by a slotted plug type flow control valve integral with the directional valve bank. A flow-control piston in the pump works against a set spring tension and positions the pump swash plate to regulate pump delivery and maintain an 18-psi pressure drop across the manual flow control valve. This pressure drop is sensed through a pilot line connected from the downstream side of the flow control valve to the pump, flow-control piston.

Continued

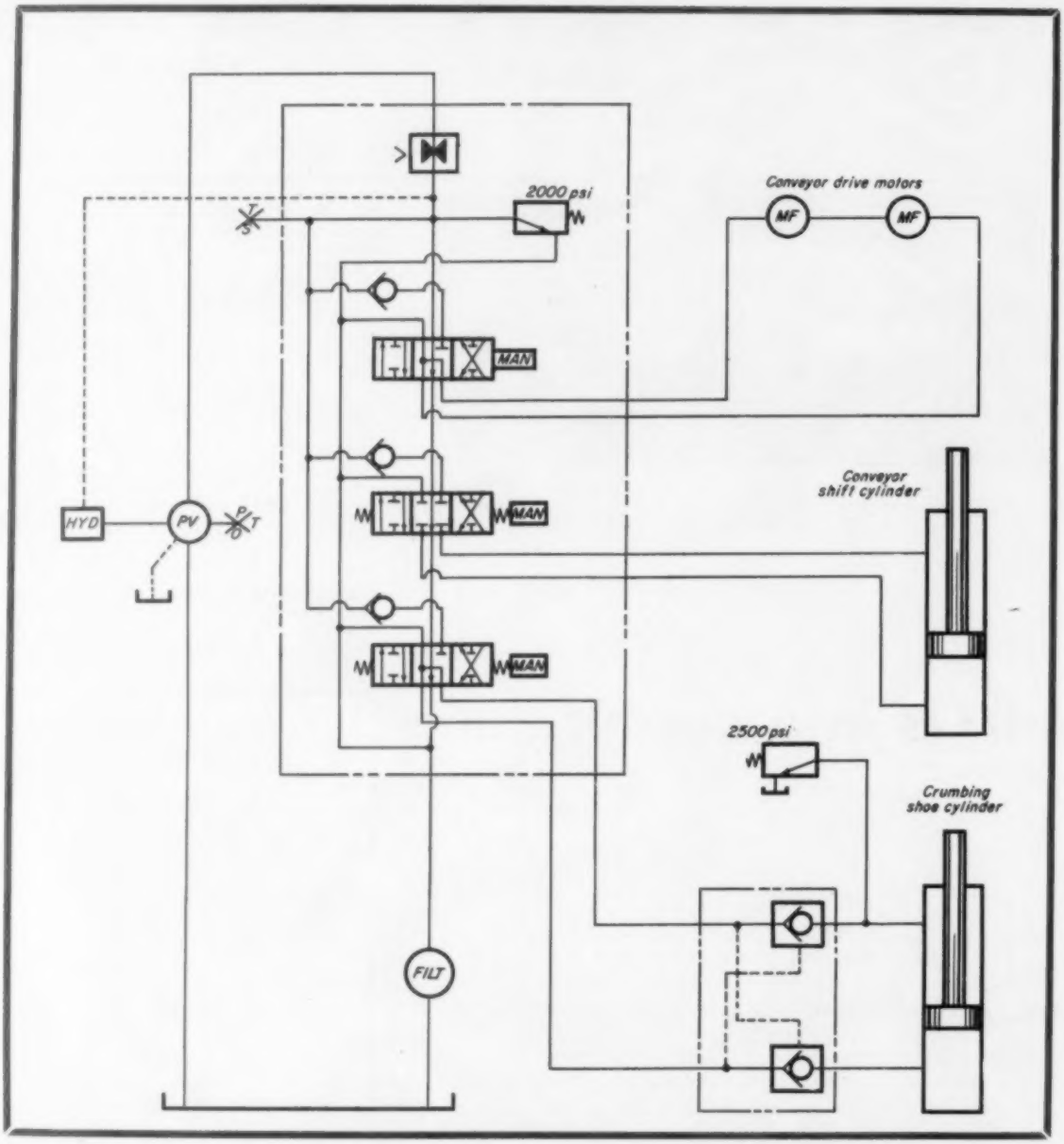


HOW WE DESIGNED FLUID MOTORS

• **Use One Fluid All Year Round**—Operation in both cold and hot weather is made possible by the variable volume pump's flow control characteristics. Automatic transmission fluid type A is used all year round. In cold weather, when the oil is more viscose, pressure drop increases across the flow control valve for any particular flow. Therefore the pump will not go to full stroke until the oil heats up to operating temperature, and suction line vacuum stays below the maximum allowable value of four inches of mercury.

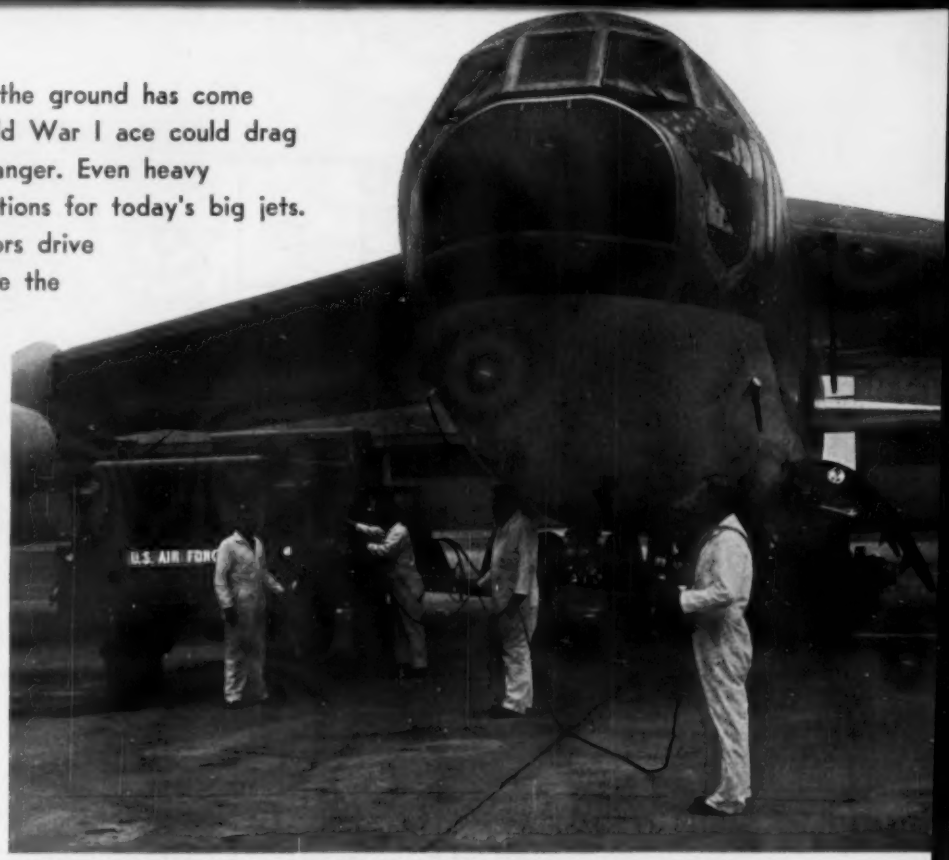
With a total pump delivery of 17½ gpm, reservoir capacity is only 5½ gallons. Warm-up time can be shortened by extending a cylinder to the end of its stroke and holding it there so that all oil passes over the relief valve and heats up.

Because the variable volume pump delivers only the oil required for set conveyor speed, oil temperature is kept at a reasonable value even in temperatures to 100 F. ▼▼▼



THREE-SPOOL VALVE BANK CONTROLS hydraulic system. Pilot-operated check valves are required as positive locks in lines to crumbing shoe cylinder. In the original design this cylinder was to be locked with a tandem center directional valve, but the inherent leakage of this spool valve required more positive locking with poppet type check valves. The directional valve for this cylinder must have its cylinder ports connected to tank in neutral position. The filter connected in the return line filters all oil before it returns to the reservoir.

Handling an airplane on the ground has come a long way since a World War I ace could drag his own Spad into the hanger. Even heavy towing trucks have limitations for today's big jets. In this system, fluid motors drive the airplane's wheels while the supply vehicle is pulled along on its casters.



GROUND HANDLING VEHICLE WHICH SUPPLIES POWER to fluid motors driving the airplane's wheels lifts up on casters so it can follow the plane's movements. Man at right has portable console to guide the plane and control its speed.

Closed system hydraulics for aircraft ground handling

How Wheel Driving Compares to Towing

Towing airplanes on the ground has two disadvantages that have made military and commercial maintenance men look to other ways of ground handling. Big jet planes are so heavy, they require a tremendous pull to move them around. Not only does this require a tow truck with lots of power but lots of weight as well to create traction, especially when airport aprons are slippery.

A second disadvantage of towing is the large turning radius required. The tow truck has to be either very low to move under the airplane, or must be connected through a long tow bar which increases turning radius. The plane's length alone makes it a ticklish job to move it into a repair area, and the large turning radius makes it even harder. To overcome these disadvantages of towing, newer methods apply power to the airplane's wheels and make use of its weight for traction. Control of the plane's speed and direction is done with a portable console.

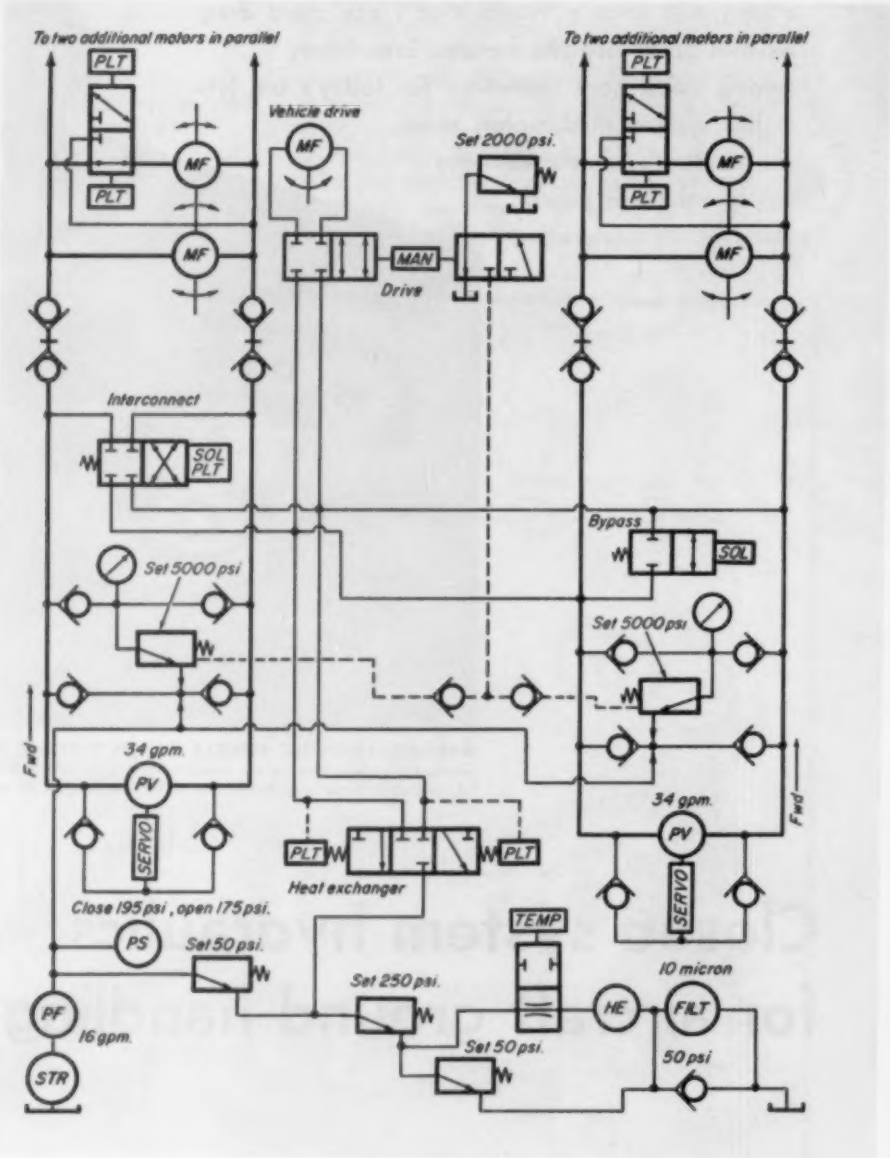
• By **R. J. ENYEART,** *Senior Project Engineer*

PETER MINNITI, *Project Engineer*

MARIO QUINTO, *Project Engineer*
Consolidated Diesel Electric Corp., Stamford, Conn.

EDWARD J. CARR, *Application Engineer,*
Hummel Technical Products, New York, N. Y.

TO GET the fine control that's needed to position a B-52 or large commercial airplane, Consolidated Diesel Electric and Hummel Technical Products have used two variable volume pumps with over-center control in closed hydraulic systems. Each pump supplies four fluid motors to drive a pair of wheels. The advantages of over-center pumps over 4-way valves is their ability to control speed as well as direction. Interconnecting the two systems assures adequate flow



AIRCRAFT AND VEHICLE DRIVE CIRCUITS are both supplied by variable volume, over-center pumps. Pilot operated relief valves, set at 5000 psi for aircraft drive, permit connecting a third relief valve set at 2000 psi for vehicle drive.

when the wheels are turning, and motors on the outside wheels require more fluid (because they turn faster) than inside wheels.

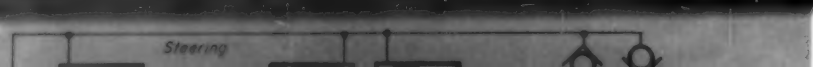
• **Integrated Ground Handling**—A vehicle carries all the equipment for ground handling: pumps, valving, motors, steering cylinders, control console. It is driven itself by a fluid motor supplied by the same pumps which power the airplane drive fluid motors.

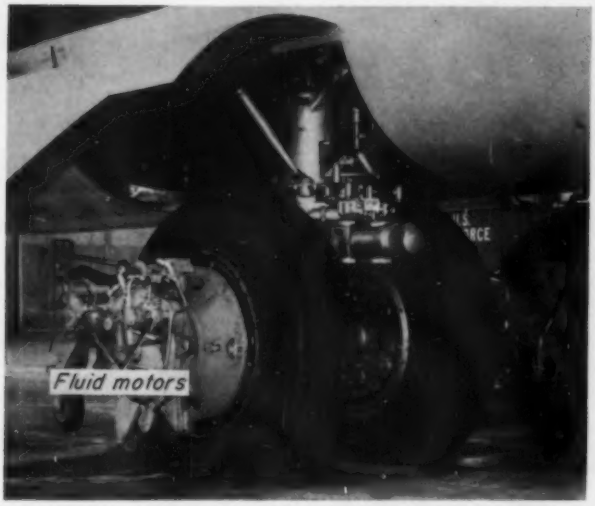
To couple the vehicle to the airplane for handling, it is driven close to one set of the airplane's eight wheels. Two wheel mover units which are in carriages installed on the front of the vehicle and two more mounted on the back are then lowered onto their own casters and rolled over to the airplane wheels. The wheel units are then mounted on each wheel.

Steering arms are connected to each set of dual wheels with a connecting bar forming a parallel linkage between them. Two steering cylinders connect to one of the steering arms, one cylinder to the other. Because of the interaction of forces through the connecting bar, only three cylinders are needed instead of four. The cylinders can exert 267,000 in-lb torque to steer the airplane.

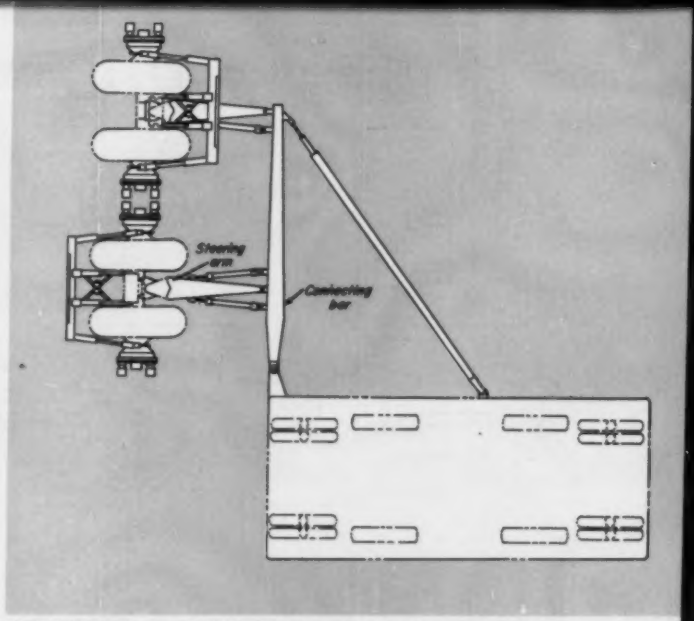
• **Bypass Motors to Change Speed Range**—After a diagonal brace is connected between the vehicle and the connecting bar, the vehicle is raised up on its casters, so that it can be pulled along by the airplane and follow freely.

Each variable volume pump supplies two pairs of fluid motors. Each pair is geared together to drive a





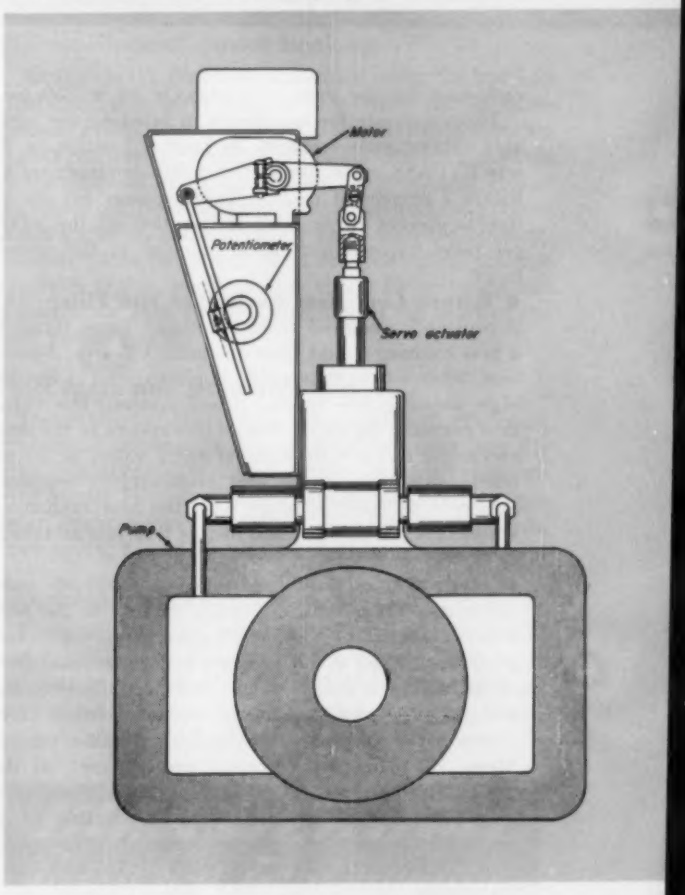
TWO FLUID MOTORS GEARED TOGETHER drive each wheel. Either one or both motors can be powered to give two speed ranges. Drive units for each pair of wheels are mounted in a wheeled carriage which is carried on the vehicle.



THREE STEERING CYLINDERS rotate the steering arms and airplane wheels around pivots on the connecting bar which forms a parallel linkage. Diagonal brace holds vehicle rigidly to airplane as it follows along on casters.

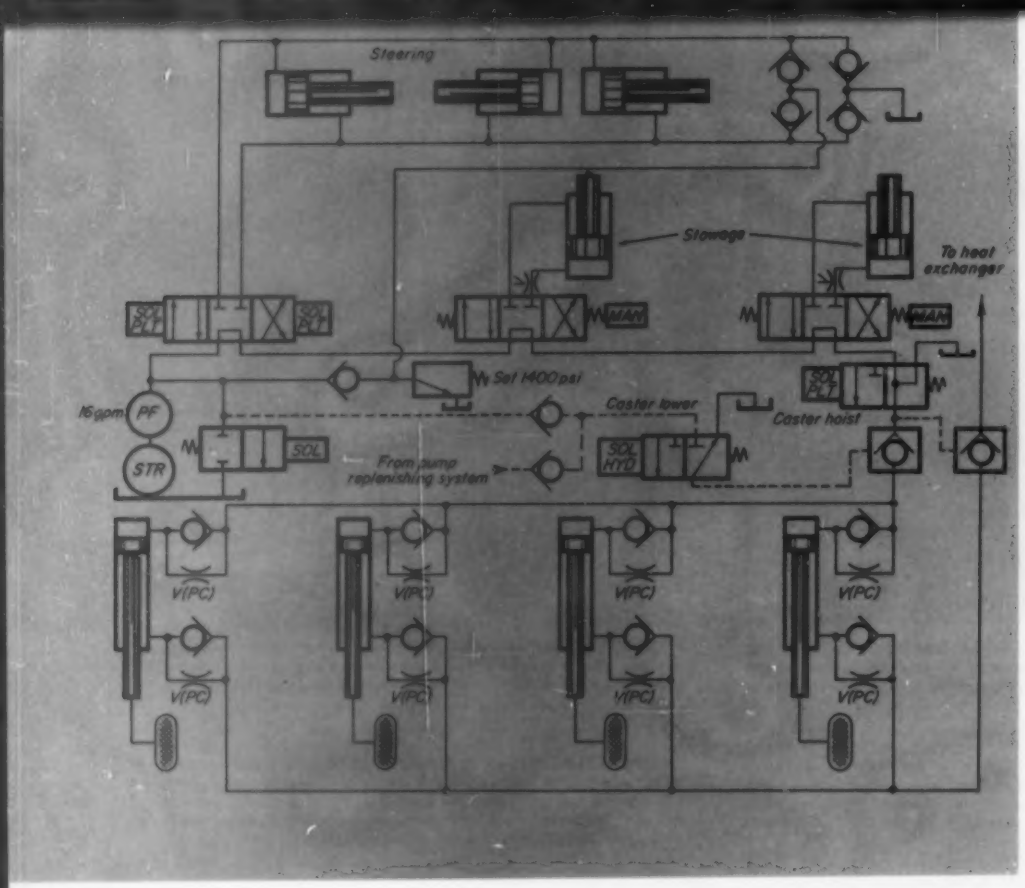
STEERING CYLINDERS are mounted on a connecting bar which links steering arms connected to each wheel pair. Wheel drive units are stowed on front and back of the vehicle. Norman Schafler, President of Consolidated Diesel Electric demonstrates use of the portable control console.

PUMP DISPLACEMENT IS CONTROLLED by a servo actuator which uses pump replenishing pressure to amplify force from the electric motor. Motor is actuated by a potentiometer in the console control, and actuates a second potentiometer which controls a similar motor for the other pump.



single wheel. The motors in both pairs are supplied in parallel and rotate in either direction for forward or reverse drive. One motor of each pair can be bypassed through a 3-way valve for higher speeds. Only one motor then drives each wheel. Because pump delivery remains the same, reducing total motor displacement by one-half doubles the speed range.

• **300-psi Replenishing**—Replenishing fluid for the two closed loops is provided by a 16-gpm, constant displacement, vane pump. This make-up fluid is directed through one of two check valves to the low pressure sides of each loop. Replenishing pressure is limited to 300 psi by two relief valves, one of these is set at 50 psi and connected to the replenishing pump. The second, which also maintains return pressure in



STEERING, STOWAGE, AND CASTER HOIST CIRCUITS are supplied from one 16-gpm vane pump. Pilot-operated check valve in line to head ends of hoist cylinders prevents vehicle from cropping until valve is actuated.

each loop for the pump actuators, is set at 250 psi.

To compensate for any errors in bringing the variable volume pumps exactly to neutral position, a 2-way BYPASS valve opens when pump displacement is within 2 degrees of neutral. This bypasses any pump flow to prevent motor creep or flow through the 5000-psi relief valves which limit pressure in the closed loops.

• **Return Line Heat Exchanger and Filter**—Oil is constantly removed from the closed loops through a heat exchanger and filter to tank. A 3-way, 3-position, HEAT EXCHANGER valve is pilot operated by the high pressure line in the closed system. The valve then connects the return line of this system to the heat exchanger through the 250-psi relief valve. A 50-psi relief valve bypasses the heat exchanger. A temperature control valve in series with the heat exchanger senses tank temperature and meters flow to maintain it at 80 degrees.

• **Hydrostatic Vehicle Drive**—A 2000-psi vane motor drives the vehicle through gearing to the rear wheels. It develops 257 in-lb torque per 100 psi, and produces 97.6 hp at this pressure and a maximum flow of 83.8 gpm. When the wheel units are disconnected from their pumps, a manually operated DRIVE valve connects the motor to the variable volume pumps. Speed and direction (forward and reverse) of the vehicle are then controlled by regulating pump displacement through a conventional accelerator pedal and FWD-REV switch to change sense of servo operation. Connected to the DRIVE valve is a 3-way valve which reduces relief valve setting to 2000 psi during driving. It does this by connecting the vent lines from both relief valves in the closed systems, to a third relief valve set at 2000 psi.

• **Checks Prevent Caster Drift**—When the DRIVE valve is closed for aircraft drive, the CASTER HOIST valve is also actuated to pass flow to the hoist cylinders. Fluid is supplied by a 16-gpm vane pump which also supplies the steering and stowage cylinders. Exhaust flow from the hoist cylinders passes through a pilot-operated check valve to the heat exchanger circuit and tank. The check valve is held open by pressure which is extending the cylinders. A check valve in the line to the head ends of the cylinders prevents them from retracting until the CASTER LOWER valve is actuated. This connects pilot pressure from either the pump which supplies the caster cylinders or from the main pump's replenishing system. Raising and lowering speeds of the caster cylinders is controlled by pressure-compensated, flow control valves connected to meter out flow in both directions.

• **Relief Valve Limits Steering Surges**—The three steering cylinders which are connected to steering arms are connected in parallel and controlled by a solenoid-controlled, 4-way valve. If a wheel hits an obstruction, a system of check valves limits pressure surges by connecting the cylinder lines through the relief valve even when the directional valve is in neutral and its cylinder ports blocked. A second set of check valves then permits flow to the cylinders to make up flow lost through the relief valve. ▼▼▼

New "built-in" application for COMMERCIAL fluid power

COMMERCIAL Model H, Series 36 hydraulic pumps were chosen by International Harvester to be the "built-in" original equipment on their new DT-817 engine.

Two pumps — one envelope

COMMERCIAL's Model H pumps, direct tandem mounted on one shaft, do double duty for the Payhaulers generating fluid power for load discharge and power steering. Pump delivery data:

Payhauler	Hoist Pump	Steer Pump
Model 65	58 gpm @ 1500 psi	18.4 gpm @ 1000 psi
Model 95	73 gpm @ 1500 psi	18.4 gpm @ 1000 psi

"95" Payhaulers on the go—Model H pumps under the hood.

"Direct-connect" power hook-up

COMMERCIAL pumps are mounted under the hood on right-hand side of engine, directly below the air compressor. Pump shaft is coupled to the Payhauler's engine crankshaft through its front gear train. Pumps are 5-bolt flange mounted direct to matching flange opening in gear train housing. In the few instances when hydraulic power is not required, a simple cover plate seals the opening. Gained: Clean cut power plant design—logical position simplifies piping, provides easy access for servicing and maintenance, plus better protection for the heart of the fluid power system.

Strict specs and standards met

International Harvester demanded high efficiency, dependable continuous duty performance over long life span. COMMERCIAL's rugged, heavy duty, high performance Model H pumps survived these rigid tests—were easily adaptable to prescribed installation standards. Once again, Model H comes out on top.

Engineering experience available

Personal technical service and assistance on fluid power applications is yours for the asking. Send today for your copy of Bulletin 100-P4. Address inquiries to Commercial Shearing & Stamping Company, Dept. A-36, Youngstown 1, Ohio.

COMMERCIAL
shearing & stamping

New, perfected-design Norgren Air-Line Filters give you these benefits:

1. Complete liquid removal.
2. Highly effective removal of solids.
3. Choice of 4 interchangeable filter elements to best suit your requirements—5, 25, 64, 74 microns.
4. New, stronger transparent bowl.
5. Larger bowl capacity and larger quiet zone for trapping collected liquid.
6. Improved baffle design prevents return of liquid to air line.
7. Quick, easy cleaning—no tools needed—only 4 parts to handle.

Where safety regulations require protection for bowls *from external physical damage—a removable metal bowl guard is available.*

Founded in 1926

C. A. NORGREN CO.

3402 SOUTH ELATI STREET
ENGLEWOOD, COLORADO

Norgren Filter removes all liquid from compressed air

The improved design of the new line of Norgren Filters provides a greater than ever liquid removal efficiency—removing all liquids over the entire range of recommended air flow. Removal of abrasive solid particles is also highly effective.

New, stronger transparent bowl is an important feature of the new filters. This bowl has a higher safety factor than ever before and a much greater resistance to fatigue.

The bowl has a larger capacity for collected liquid. The "quiet zone" below the baffle holds 53% more collected air-line contaminants—requires less frequent draining.

Servicing is easier and quicker. No tools are required to disassemble the filter for cleaning, and there are only four separate parts to handle.

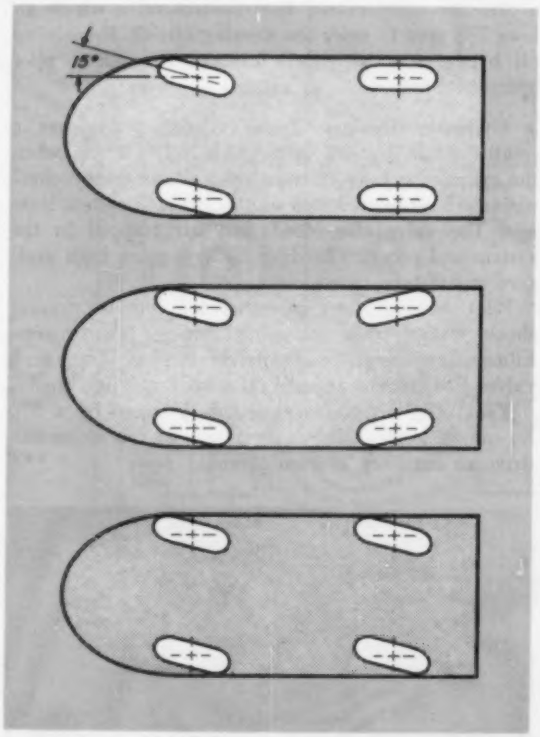
For complete information about the money-saving features of the Norgren complete line of manual drain and automatic-drain filters, call your nearby Norgren Representative, listed in your telephone directory—or **WRITE FOR BROCHURE NA-1.**

SHIP TO SHORE CARGO CRAFT can drive its four rubber-tired wheels or its propeller simultaneously or independently. During recent tests, the LARC—Lighter Amphibian Resupply Cargo—made a successful 56 mile crossing of Lake Michigan from Benton Harbor to Chicago.

Instead of mechanical feedback common in most automotive power steering systems this military amphibian uses steering cylinder exhaust fluid to re-center the steering valve.

Hydraulic feedback helps steer the Larc

• By **OTTO NEUMAN,** *Hydraulic Group Engineer*
and **JOHN HARNEVIOUS,** *Senior Designer*
Ingersoll Kalamazoo Div., Borg-Warner Corp., Kalamazoo, Mich.



HYDRAULIC POWER STEERING SYSTEM provides the LARC with unusual mobility. Through the steering mode selector, the operator can choose one of three patterns: front wheel, radial, or oblique. The wheels turn a maximum of 15 degrees.

A 15-TON amphibian developed for the Army has two steering cylinders mounted at each wheel. These cylinders are interconnected so that steering force is coordinated at corresponding wheels. Their rod ends are interconnected to insure synchronized movement at opposite wheels. Two cylinders at the front wheels are connected to a servo feedback actuator providing follow-up to close the steering valve when the wheels turn to the required position.

• **Steering Mode Selection**—The driver must select one of three steering modes: front wheel, radial, or

Choose from a COMPLETE LINE of steel fluid power fittings and accessories

A—JIC Flare Tube Fittings
B—Manifold Fitting
C—Needle Valve
D—Pipe Nipple
E—Flange Manifold
F—Straight Thread, "O" Ring Seal Fitting
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Circle **52** on Time-Saver Card

oblique by setting the 4-way, 3-position steering mode selector valve. This valve channels oil to the appropriate rear wheel cylinders for radial or oblique steering. At the same time, the wheel synchronizer valve shifts to correspond to steering mode. This connects rod ends of two rear wheel cylinders to rod ends of two front end cylinders to keep wheels matched according to steering mode.

• **Hydraulic Follow-up**—When the driver turns the steering wheel, he actuates a 4-way, 3-position steering valve directing oil flow to the appropriate cylinders. It takes four turns of the steering wheel to go from full right turn to full left.

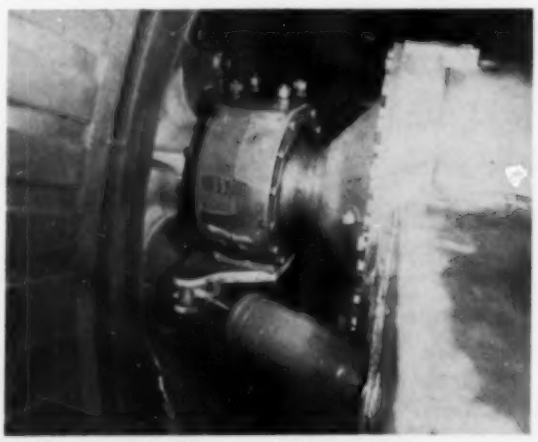
The servo feedback actuator powered by the exhaust oil from the rod ends of two front cylinders recenters the steering valve as the wheels turn. The servo feedback actuator also actuates an electric indicator which shows the driver *actual* position of the wheels

• **Priority Sequence**—The LARC is designed with an open center system which requires priority valving. The steering system always receives priority through a pressure compensated flow control valve which allows 7½ gpm to enter the steering circuit. Remaining oil bypasses to secondary circuits through a pilot operated check valve, or returns to reservoir.

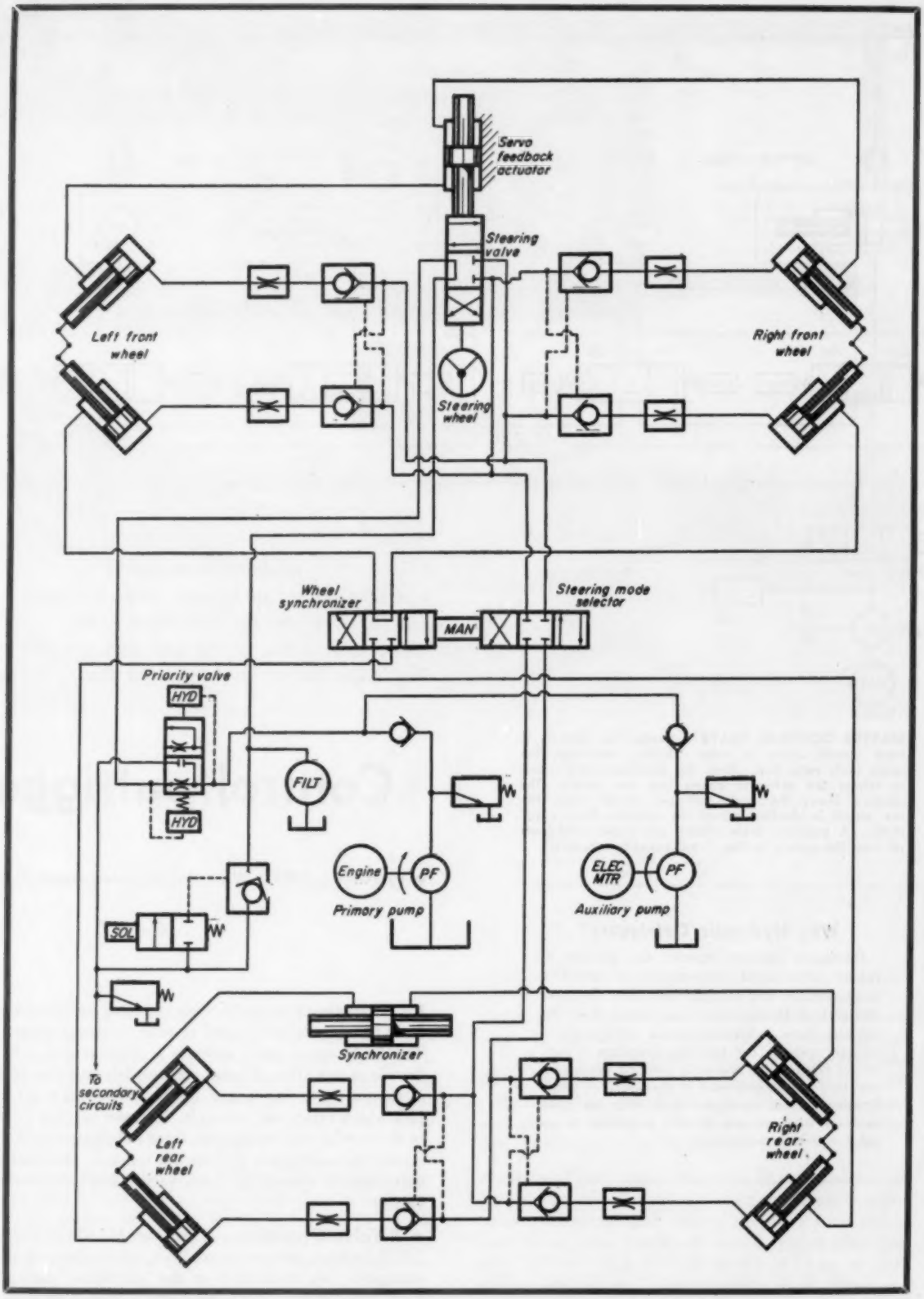
• **Cylinder Design**—Each cylinder piston has a small built-in bypass valve. This valve opens when the cylinder is fully extended and allows the synchronizing circuit to replenish oil lost through system leakage. The valve also bleeds any air trapped in the system and prevents holding the system on high pressure at full turn.

Pilot operated check valves at each cylinder prevent shock waves from travelling through the system. Eliminating shock lessens driver fatigue. The check valves also lock the cylinders if a hydraulic line breaks.

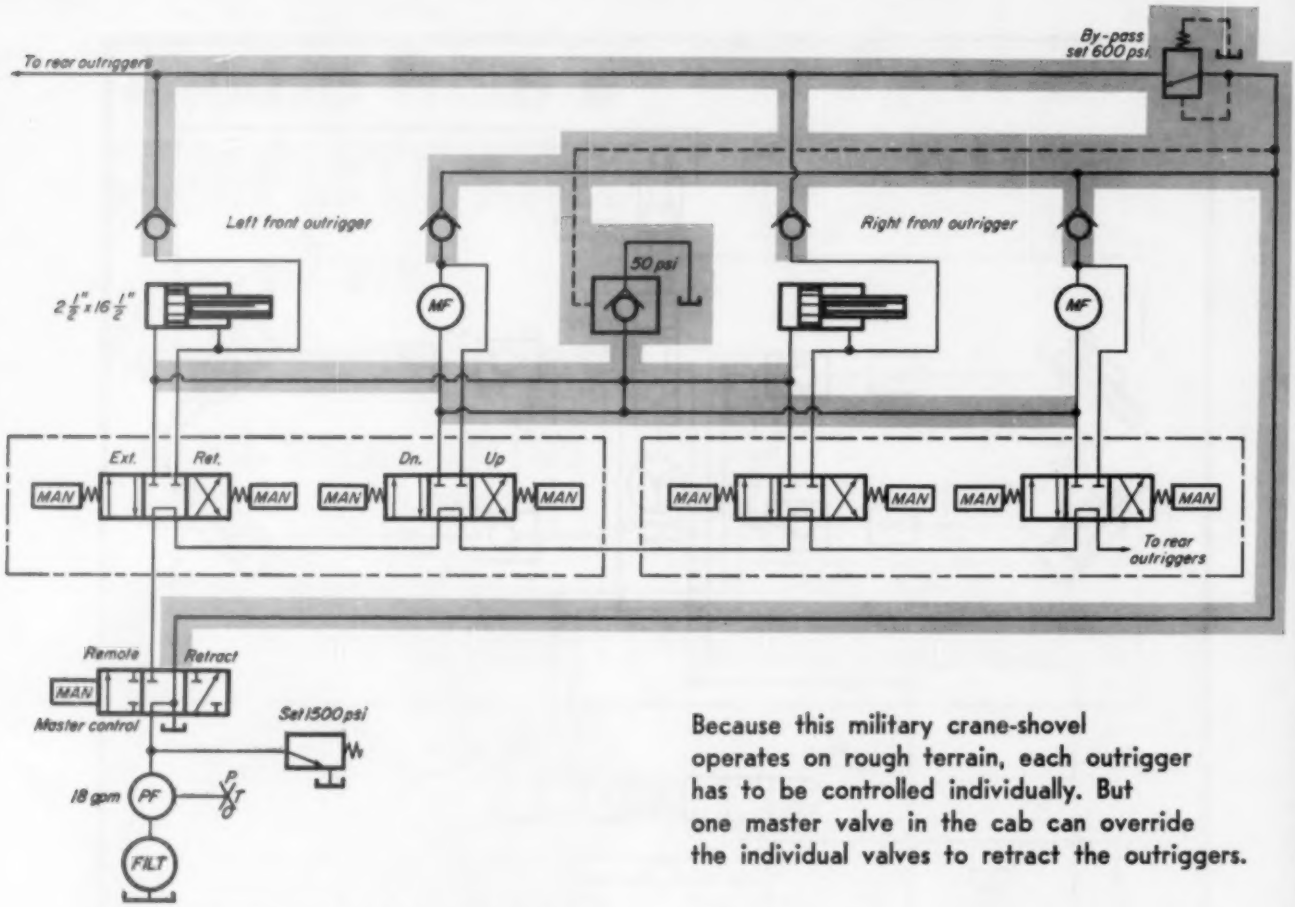
The LARC hydraulic system is powered by a 270 hp engine. If this fails, an auxiliary, 24-volt motor can drive an auxiliary hydraulic pump. ▼▼▼



WHEEL IS ACTUATED by two cylinders. Cylinder end is connected to flange on wheel and head end is anchored to chassis. A second cylinder on the opposite side turns the wheel in the opposite direction.



STEERING WHEEL ACTUATES steering valve, porting flow to cylinder head ends. Rod end fluid exhausts to servo feedback actuator recentering steering valve. Steering mode selector and wheel synchronizing valve are actuated together to connect flow for steering rear wheels.



MASTER CONTROL VALVE activates the central retract circuit shown in color. During retraction, the screw jacks raise first. Then the sequence valve opens to retract the outrigger beams into the vehicle. The diagram shows the front outrigger circuit only. The rear circuit is identical except the cylinders have a 20" stroke. A separate drain circuit, not shown, withdraws oil from the system to the 13-gal capacity reservoir.

Why Hydraulic Outriggers?

Outriggers increase capacity and stability of rubber tire-mounted crane-shovels by providing firmer support over a larger base. Army Engineer Research & Development Laboratories have developed these hydraulic-powered outriggers for military cranes. They have the advantage of individual control like manually-powered outriggers, and they can be emplaced in mud, surf, or rough terrain. Manual outriggers work only on pavement or hard ground. Central retraction is another hydraulic advantage.

Because this military crane-shovel operates on rough terrain, each outrigger has to be controlled individually. But one master valve in the cab can override the individual valves to retract the outriggers.

Control outriggers

• By **JOHN L. TERRY,** *Mechanical Equipment Branch, U. S. Army*

EACH outrigger is emplaced or retracted independently through valves located at each outrigger station. The double-spool valve controls a cylinder and a hydraulic motor. The cylinder controls lateral movement of the outrigger beam, and the motor rotates a screw jack which raises and lowers it. A master control valve in the carrier cab can by-pass these outrigger valves to retract the outriggers. For central reaction, the master valve uses a system of check valves and a sequence valve.

• **8-Valve Operation**—When the MASTER CONTROL valve is in *remote* position, all motions of the outriggers are controlled at the individual stations. Each doublespool valve is manually-operated. With the outrigger valve in *extend* position, the cylinder pushes the outrigger beam outward. Fluid from the rod end

HYDRAULIC OUTRIGGERS in place on a 15-ton, 6 x 6 crane carrier. Construction equipment as well as combat equipment must be capable of off-road operation on the atomic battlefield.

with 8 valves . . . or 1

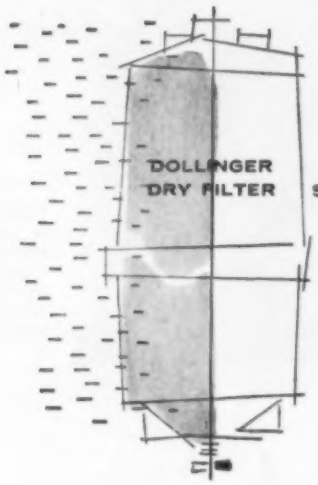
Engineer Research & Development Laboratories, Fort Belvoir, Va.

of the cylinder flows to tank. After the beam is fully extended, the valve controlling the fluid motor is shifted to *down* position. The hydraulic motor turns a worm wheel which drives the screw jack down. The screw jack column is long enough to move the jack pad up to six inches below ground plane. This simplifies levelling the crane on uneven terrain.

• **Retracting with One Valve**—The outriggers are retracted in two ways. By individual valves at each outrigger station or by the master valve. In its *retract* position the master valve directs all oil from the pump to a secondary retract circuit for the cylinders and motors.

A pilot-operated check valve opens to allow return fluid from the motors to flow through a secondary return line to the reservoir. A sequence valve insures that the jacks are completely raised before the beams begin to retract horizontally. This prevents damage to the screws. Because the motors are in parallel, like the cylinders, the jack supporting the least weight rises first. When the four jacks are up, system pressure rises to 600 psi and opens the sequence valve. The cylinders then retract the four beams together.

• **Same Pump and Motors**—The pump and all four motors are identical. This is a considerable maintenance advantage and reduces the spare parts inventory. Motor-pump specifications: 18 gpm at 1800 rpm and 2000 psi. Torque is 560 in-lb and 15 hp at 1500 psi and 1800 rpm. The screw jack's worm wheel and gear arrangement has a speed-torque ratio of 27:1. In case of hydraulic failure the screw jacks fail-safe because they are self-locking. ▼▼▼



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Circle **47** on Time-Saver Card

If you supply your steering cylinders from a small pump separate from that which supplies other hydraulic operations, steering speed will depend on engine speed. This is all right for smaller vehicles, but it's not much good for large heavy machines. Here's how engineers at Frank G. Hough increased pump capacity for a large front-end loader and made sure they had a constant steering supply.

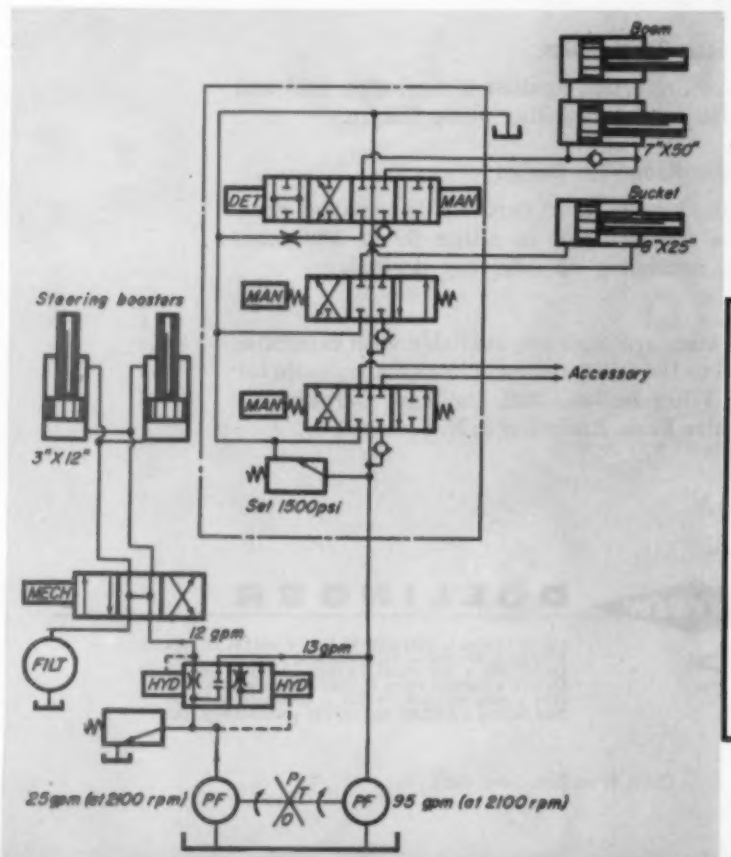
How to use a

• By **DON S. STRADER**, *Project Engineer, Frank G.*

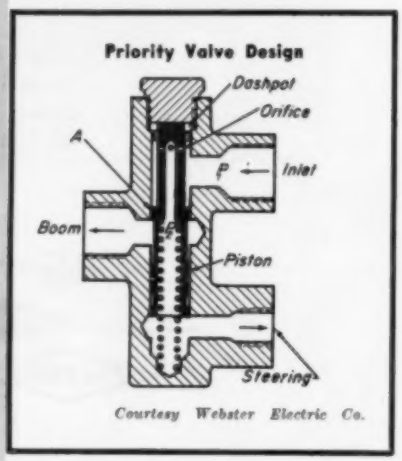
IN SMALLER SIZE Payloaders, we have a nominal pump delivery for steering of 6 gpm at 1200-rpm engine speed. At 600-rpm idle speed, flow to the open-center steering valve is 3 gpm and at 2100-rpm full speed it is 11 gpm.

On larger machines, we need a nominal steering flow of 12 gpm. We also need more than the 95 gpm we can get from the biggest pump available for 1500 psi. Because we had to use two pumps, we selected a 25-gpm size for the smaller one and directed 12-gpm of its delivery to the steering circuit through a flow divider or priority valve. This maintains a 12-gpm flow to the steering system and directs the remaining flow to the main directional valve.

• **What a Flow Divider Does**—The simplest flow divider is a tee connection which allows flow to separate into two pipes. This works all right if pressure in both circuits is exactly the same. But if they aren't, fluid takes the path of least resistance and



TWO STEERING BOOSTER CYLINDERS are needed for larger vehicles. Interconnecting rod and head ends insure a constant work area in each direction.



LOADER HAS PRESSURIZED RESERVOIR to help keep out dirt. This 15 to 30-psi pressure also supercharges the pumps and permits smaller inlet lines. A 10-micron pre-cleaning filter is installed in the reservoir during initial running and test. It is replaced by a 40-mesh suction screen when the machine is shipped. A 15-micron filter is in the steering circuit return line.

priority valve

Hough Co., Libertyville, Illinois.

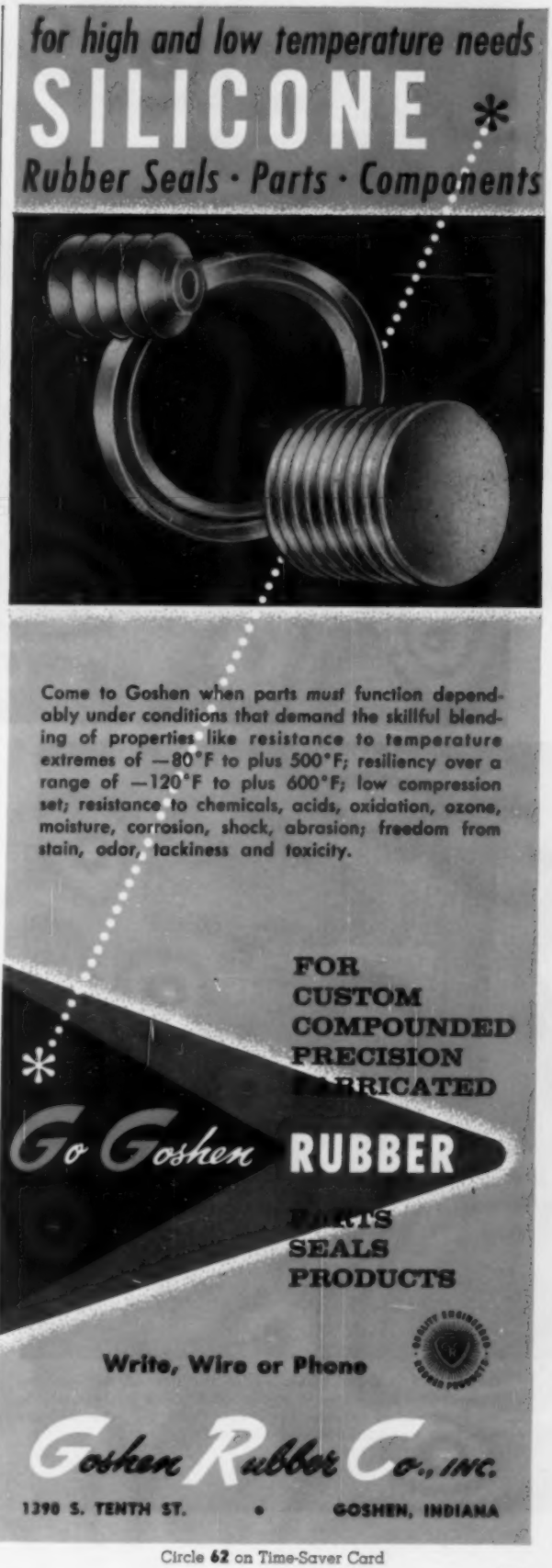
flows into the branch which is at lower pressure. You can overcome this in several ways—by using pressure-compensated flow control valves, or fluid motors shafted together to act as metering devices.

A priority valve is a special kind of flow divider which directs a fixed flow to one circuit regardless of input flow (as long as input flow is equal to, or more than fixed flow) and directs the rest to another circuit. Basically the priority valve combines a pressure-compensated flow control valve with a metering, sequence valve (see circuit diagram). The flow control valve meters a fixed flow to the steering circuit regardless of pressure. At rated flow (12 gpm in this case) pressure opens the sequence valve which directs flow in excess of 12 gpm to the circuit operating other vehicle functions.

• **How a Priority Valve Works**—The priority valve which is used in this application is shown with the circuit diagram. Flow from the valve inlet to the steering circuit is through the orifice and hollow piston. Because forces on the piston are balanced, pressure P_1 upstream of the orifice exceeds pressure P_2, downstream of the orifice by a fixed amount, corresponding to spring force. This relation remains constant regardless of variations in steering pressure or inlet pressure. Therefore the orifice acts as a pressure-compensated flow control valve.

Flow in excess of the orifice rating (12 gpm) raises pressure P_1 which pushes the piston down and opens a path to the boom circuit across land *A*. As long as pressure in the boom circuit is less than steering pressure, inlet pressure remains a fixed amount above steering pressure (about 50 psi depending on spring force).

When pressure in the boom circuit rises above steering pressure, inlet pressure raises to the higher pressure, plus pressure required to overcome the spring force, and pushes the piston down, metering steering flow across the piston's lower face. ▼▼▼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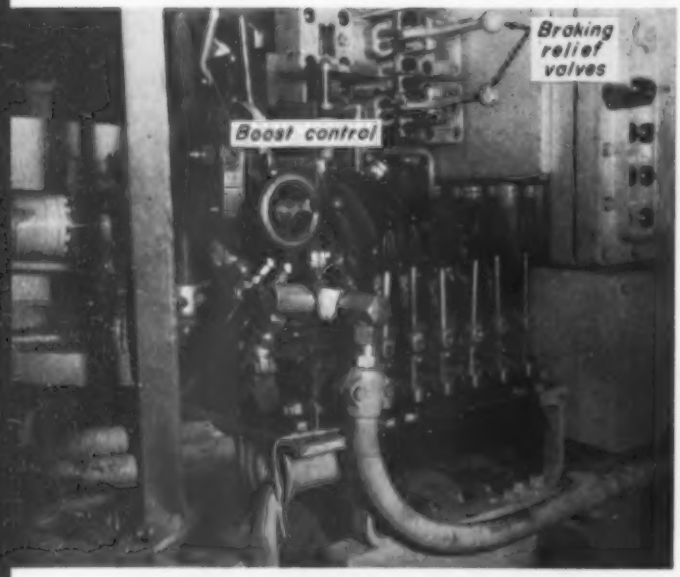
Overcenter pump saves mining



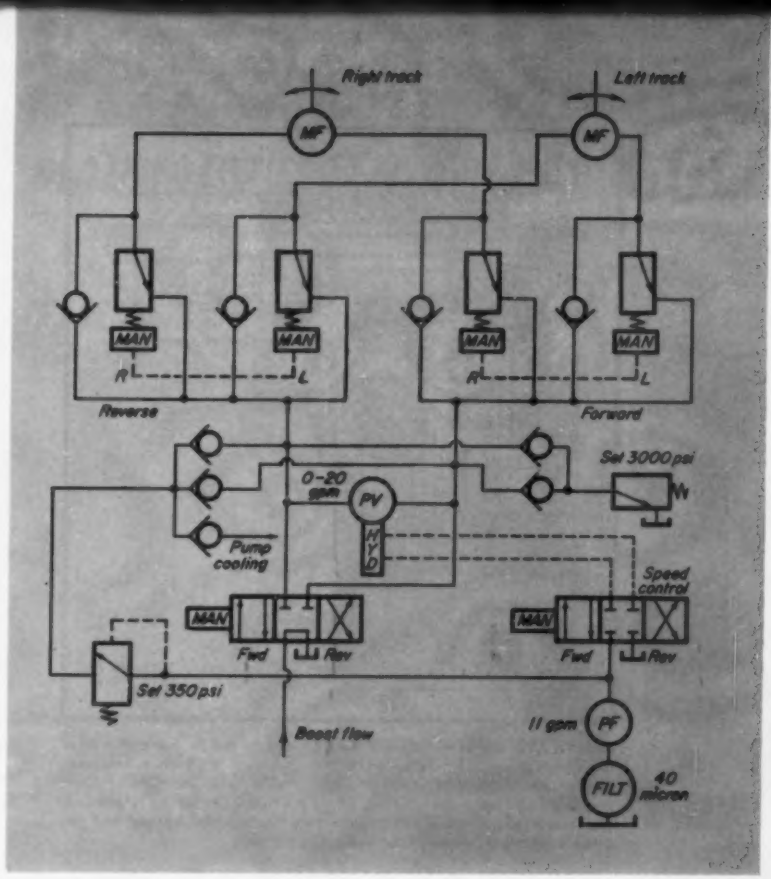
OPERATOR'S CONTROLS are at the side of the machine. Brake levers actuate relief valves which apply backpressure to the fluid motors to steer the borer. Boost control adds extra flow from an 8-gpm pump for fast speed.

• By **JOSEPH J. SLOMER**, *Chief Hydraulic Engineer* and

TWO fluid motors drive the tracks on Goodman continuous borers. They're supplied with variable and reversible flow from a 20-gpm variable volume, axial piston pump. The pump's overcenter control permits it to deliver from either port, driving the motors and borer in either forward or reverse.

Displacement control for the pump has been revised several times since the overcenter pump first replaced a 4-way directional valve to control motor rotation. The pump mounts on the opposite side of the machine from the operator's controls, so it needs remote control. At first this was a mechanical linkage, but this design had too much backlash. It allowed the pump to hunt near its neutral position and didn't give the fine control that is needed.

A closed circuit, hydraulic control system using master and slave units was then tried, but it was not rugged enough to stand up under severe operation in

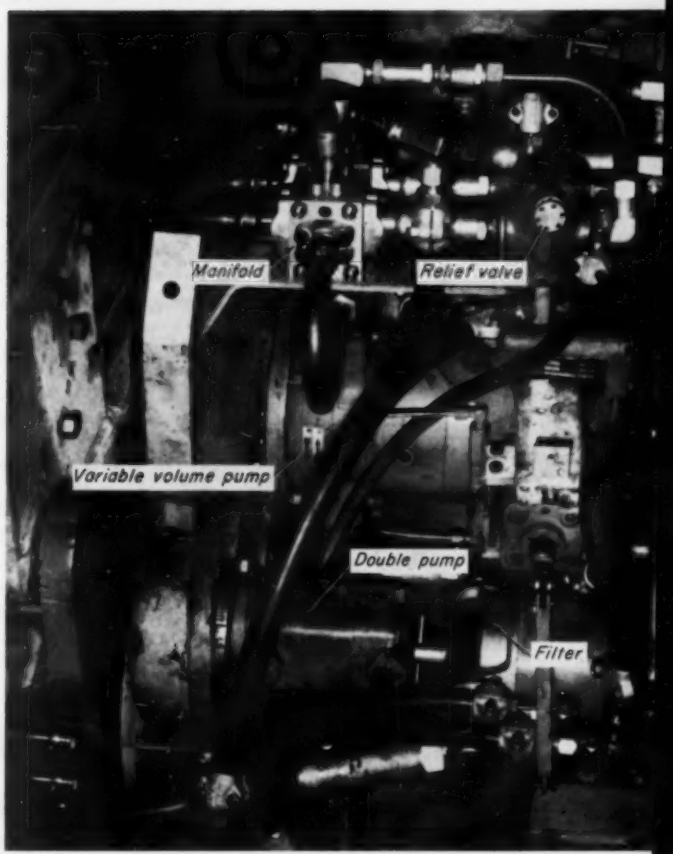


PARALLEL CONNECTED FLUID MOTORS drive the borer's tracks. Relief valves control steering by braking the motors with backpressure. The valve's springs are compressed by two levers, one for forward travel, the other for reverse. Pump cooling flow is through variable volume pump case.

PUMP INSTALLATION packs a lot of components into a small space. Manifold makes connections for pump replenishing and relief valve. Hose ends are clamp-on type. Welded on split flanges connect lines to manifold.

machine space

MEL CARLSON, *Design Engineer, Goodman Mfg. Co., Chicago, Ill.*

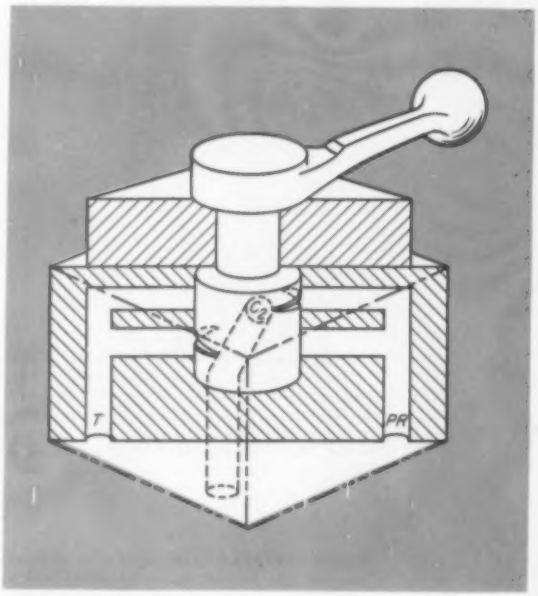


the mines. Operators worked it too fast, built up surge pressures, and broke drive shafts off the master unit.

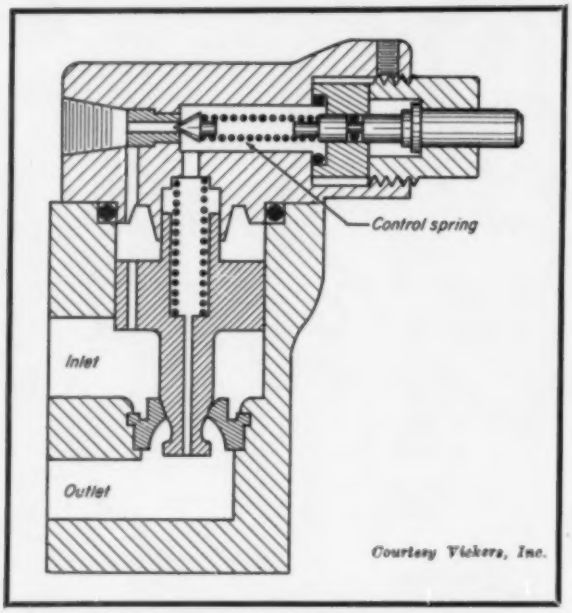
A push-pull cable operating a servo control on the pump was one design in this pump control development, but again this was not fine enough and had too much backlash.

The present design, which is very successful, has a 4-way rotary valve, metering flow to a hydraulic control on the pump. This is an open loop system in which the operator eases the valve open in either position to increase or decrease pump displacement and speed up or slow down the borer. The valve has metering slots cut 1/16" deep and extending more than 90 degrees around the circumference of its spool. These slots meter fluid into the pump displacement control and out of it, so the operator can control acceleration.

Steering is done by braking one of the tracks using two levers which control relief valves in the fluid



ROTARY VALVE has long metering slots for fine control of pump displacement and borer speed changes.



BALANCED PISTON RELIEF VALVE connected in the motor lines for braking has stem-actuated control spring. With stem released, flow passes from inlet port to outlet with little restriction. Only pressure required to lift the piston against its light spring is needed. The operator's brake lever compresses the control spring and increases pressure required to open the valve.

motor circuits. Instead of the common screw adjustment, each relief valve has a stem which is depressed by the brake lever. This compresses the valve's spring and increases pressure of fluid exhausting from the motor. This backpressure on the motor brakes it and slows down the track. One brake lever is used when the borer is moving forward; the other is for reverse travel. A vane type, double pump having 8-gpm and 11-gpm sections is driven from the same gearing as the variable volume pump. To increase borer speed, flow from its 8-gpm section can be added to delivery from the variable volume pump. The 8-gpm pump also supplies other hydraulic functions on the machine. One relief valve connects to the pump lines through check valves to limit pressure to 3000 psi in both directions of pump rotation.

The 11-gpm section supplies cooling flow through a sequence valve to the variable volume pump casing. Check valves also connect its delivery to the variable volume pump's lines to supply whatever replenishing fluid is required to make up leakage. The 11-gpm pump also supplies fluid for controlling the variable volume pump. The sequence valve insures that this fluid is always available at 350 psi. ▼▼▼

How Goodman Combats Contamination

No equipment works in a dirtier atmosphere than mining machines. Here are design features of the continuous borer to keep the hydraulic system clean.

1. A filler pump which can be power operated takes oil from a portable filling can and delivers it to the borer's reservoir without the risk of adding contaminants while the filler cap is off.

2. A strainer is connected in the filler pump line.

3. Intake strainers remove particles which may get into the system when lines are disconnected. The strainers are 30 mesh.

4. A micronic filter removes particles as small as 40 microns. There is a relief valve in the filter circuit and a sight indicator to show when the oil is bypassing the filter element.

5. Baffles in the tank help collect materials which do not remain in suspension permanently.

6. An automatic bleed-off valve has replaced a needle valve formerly used for bleeding air. Bleeding is important because if there is air in the system, the pump may not build up pressure until the air pocket is removed.

8. To make a final check on the intake side of the pumps, there is an outlet for a vacuum gage, and readings are recorded on all machines.

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MANUAL WATER VALVES

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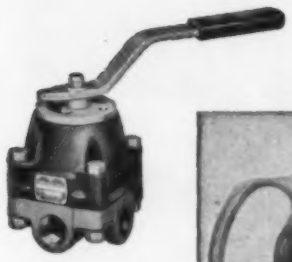

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Note the mirrorlike sealing surfaces on this Dual Pressure Valve rotor after 4 years of service.

On extrusion presses, die casting machines, rubber and plastic molding presses and on blowout preventers, they have performed without maintenance longer than any other type of valve.

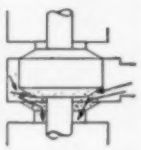
This LONG, MAINTENANCE-FREE SERVICE is possible because the metal-to-metal sealing surfaces are self-aligning and actually improve with use through continued lapping action. Sealing qualities do not diminish because a spring compensates for the wear.

DIRT CANNOT SCORE SEALS because flow is through "Shear-Seals," sealing surfaces remain in constant intimate contact.

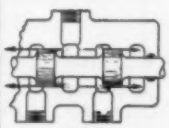
COMPLETE CONTROL OF YOUR CIRCUIT because "Shear-Seal" design is excellent for throttling. It permits opening to any desired degree of flow with smooth action and without fighting fluid pressure.

The "Shear-Seal" action eliminates line surges and the round tubular flow passages provide more flow and velocity capacity (up to 60 ft. per sec.) because they are unobstructed by spools or poppets.

This is why we don't use **SPOOL OR POPPET DESIGN**



Poppets score



Spools leak

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CONTROL VALVE DIVISION

barksdale valves

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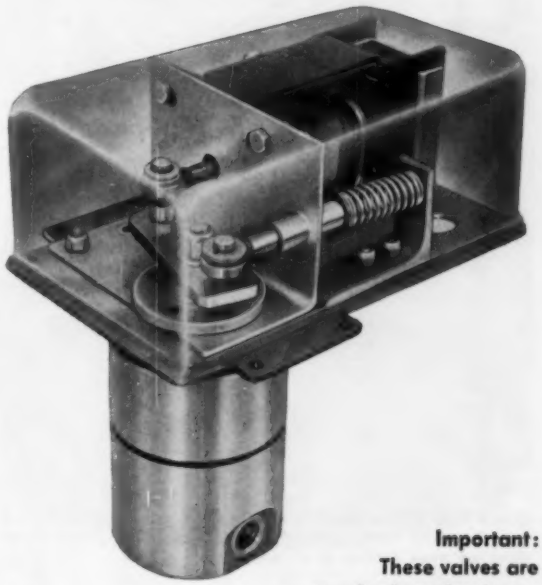
10,000 P.S.I. SOLENOID VALVES



Important: These valves are standard catalog items.

● They are available for immediate delivery (in stock) at standard valve prices, for a service which generally requires costly (made-to-order) special valves.

● Shut off and 4-way valves in ¼, ⅜ and ½ inch port sizes are rated for 10,000 P.S.I. liquid or gases. They will withstand surges of up to 15,000 P.S.I. without damage to the valves' sealing qualities (designed for a burst pressure of 30,000 P.S.I.).
Solenoids are available for 115, 230 and 460 volt A.C. operation.

● Long maintenance-free service is achieved through the leak-proof "Shear-Seal" design. Optically flat metal to metal sealing surfaces (of the self-aligning sealing rings and the mating rotor face) are protected by staying in constant intimate contact: flow is always through the center of the "Shear-Seals," never across sealing surfaces. Sealing qualities actually improve as the seals lap themselves to a more perfect fit with each valve operation. There is no external shaft leakage because the pressure is confined to the flow passages.

For complete data write for catalog S-10000.

CONTROL VALVE DIVISION

barksdale valves

5125 ALCOA AVENUE • LOS ANGELES 58 • CALIFORNIA

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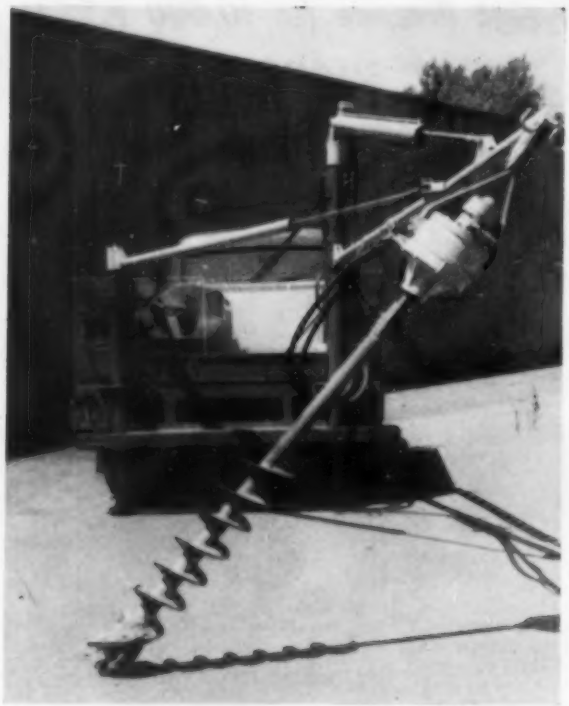
Circle **18** on Time-Saver Card



ONLY THE BOOM RAISING CYLINDER extends while drilling a verticle hole. Both cylinders are coordinated for proper force direction when drilling at an angle.

Coordinate cylinders to direct force

• By **HARVEY BERGHAUS,** *President, Transport Products Co., Cleveland, Ohio*

TWO double-acting cylinders control this auger while it's drilling holes at an angle or straight down. One cylinder mounts on the same post as the auger boom. As the cylinder extends, it gives a downward thrust. The other cylinder mounts at an angle to the boom and gives the auger its horizontal component of drilling thrust.

When drilling a straight hole (left photo) only the down acting cylinder extends. Drilling at an angle for pole anchors (right photo) requires coordinating both cylinders for proper resultant force.

Each cylinder is controlled by a manually-operated valve. Commercially available spool valves give sufficient throttling for the operator to control angle drilling.

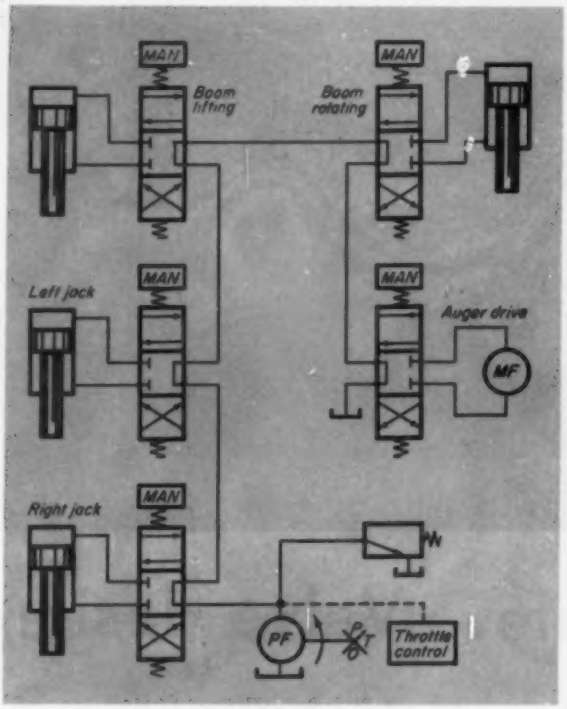
• **Fluid Motor Auger Drive**—A vane type, fluid motor drives the auger through an 18:1 reduction gear. The motor delivers 740 in.-lbs. torque at the system's operating pressure of 2000 psi.

A power take-off from the transmission drives the hydraulic pump for the system. At an engine speed of 1800 rpm, the pump delivers 21 gpm at 2000 psi.

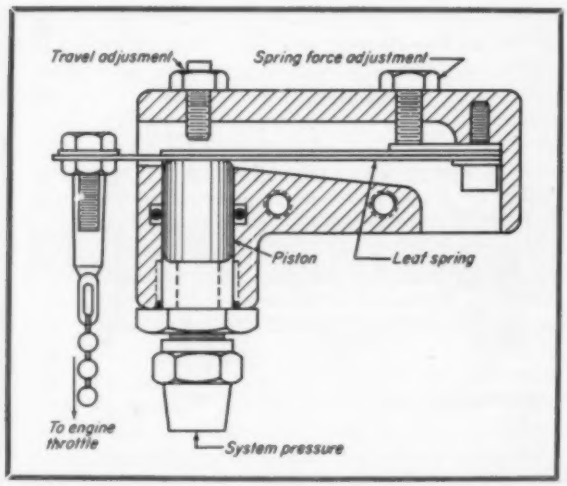
• **Automatic Control of Pump Speed**—A pressure-actuated throttle control speeds up the engine when the hydraulic system operates. Otherwise the engine idles.

With the system's tandem-center valves in neutral, the pump unloads through the valves to tank. With no pressure on the throttle control, the engine idles. When one of the control valves actuates, system pressure rises and shifts the throttle control. The engine speeds up and delivers more oil to the system. When the valves return to neutral, system pressure falls, and the throttle control returns the engine to idling speed.

The throttle control mounts on the engine head. It has a piston exposed to system pressure on one end,



PUMP UNLOADS through the tandem-center valves when the system is idle. Force is applied for angle drilling by manipulating the manual control valves which meter flow to the boom cylinders.



THROTTLE CONTROL for engine driven hydraulic pump idles the engine when the hydraulic system is not in use and the pump is unloading. When a valve shifts and pressure increases, the control opens the throttle and speeds up the engine.
Courtesy Stratton Equipment Co., Cleveland, Ohio

and the force of a leaf spring on the other end. A chain connects the spring to the engine throttle. When fluid pressure rises enough to overcome spring force, the piston pushes the spring back, opening the engine throttle, and speeding up the engine for full pump delivery. ▼▼▼

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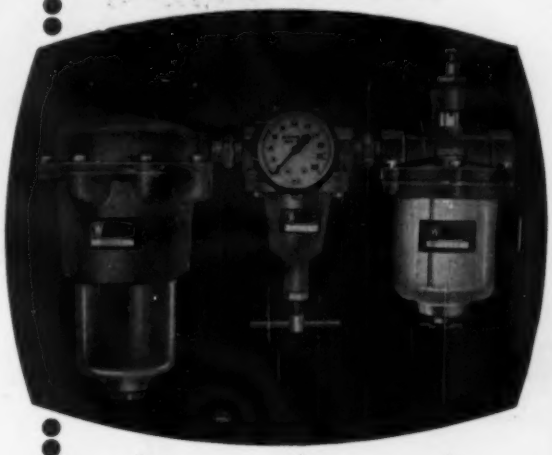

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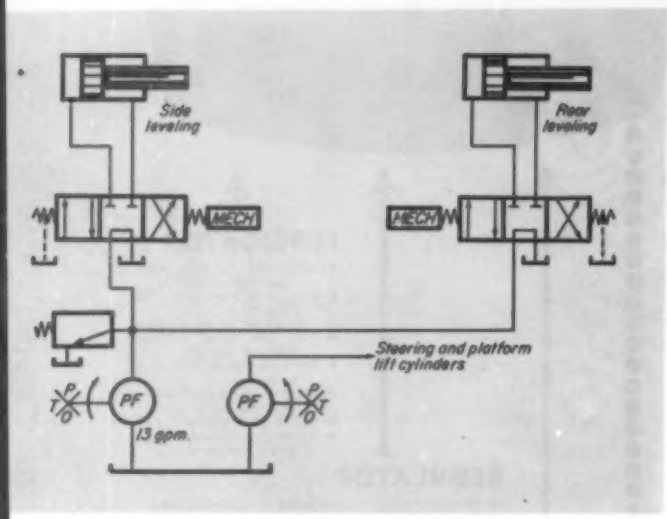
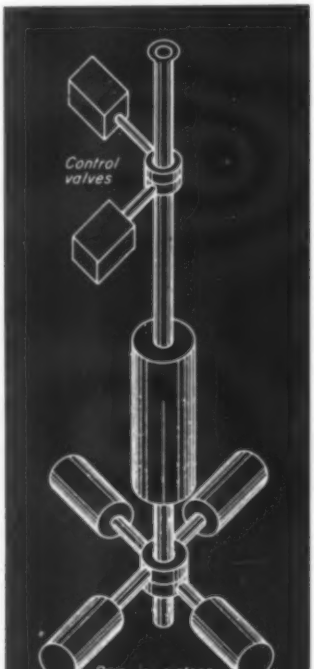
Valve design

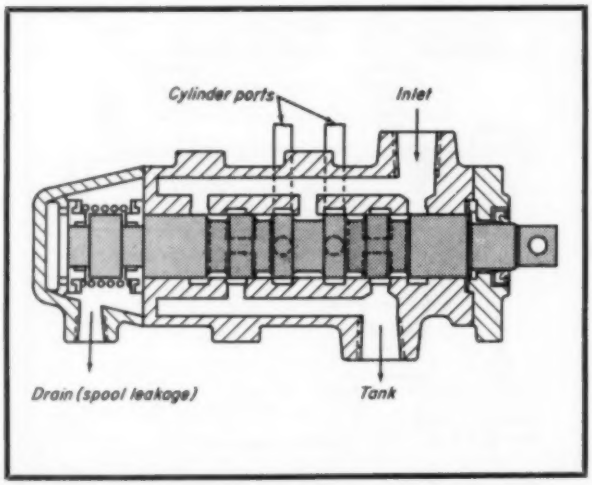
• By S. D. POOL, *Chief Engineer, Advanced*



A SEPARATE PUMP powers the leveling circuit. In neutral position tandem valves pass full pump flow of 13 gpm to unload pump.



PENDULUM for operating the control valves is 36 in. long and weighs 100 lbs. Its swing is dampened by four loose pistons operating in 3-in., oil-filled cylinders.



SPOOL AND VALVE BODY LANDS are machined to a tolerance of .0012 in. to maintain valve balance under all operating conditions. As the valve opens the cylinder port, it closes the pump-to-tank passage, so that total orifice area remains constant. To float the spool and allow easy operation .03 to .05 gpm is allowed to leak past the spool ends. A built-in relief valve prevents over-pressure from thermal expansion.

Another combine leveling system was described in the Dec., 1959 issue of HYDRAULICS & PNEUMATICS. *It uses a small fluid level which varies the pressure on a rolling diaphragm. A linkage attached to the diaphragm actuates limit switches which shift 4-way solenoid valves to level the combine.*

Two cylinders keep this harvester's operator level while its cutter follows the grade. Valves controlling these cylinders are actuated by a pendulum which remains vertical. Because of the small actuating force, the valves needed special wiping lip seals to reduce spool friction. Small actuating movement required close valve tolerances and damping to prevent oscillation.

for combine leveling

Engineering Dept., International Harvester Co., Hinsdale, Ill.

HILLSIDE harvesting requires that the cutting reel follow the grade while the operator and harvesting mechanism remain vertical. Two hydraulic cylinders—one at the rear of the machine and one on the side—level the combine about two axes. Directional valves for these cylinders are controlled by a level-seeking device mounted on the harvesting mechanism. Engineers at International Harvester use a free-swinging pendulum to actuate the control valves directly.

Safety considerations require a fast leveling response for swinging on turns and crossing ridges. However, too fast response jars the operator and gives him a pitching ride. A leveling speed of 3.5 degrees per second crosswise and 2.3 degrees per second fore and aft keeps the combine following the land level and gives the operator comfort and a safe feeling. When the machine is stopped, it comes to level and stops there. Operator comfort also requires a completely dampened system in which no oscillation can be induced.

The leveling system they tried first had a pendulum rod acting directly on two 4-way valves. The valves were mounted at 90 degrees to each other, one controlling side leveling and the other fore and aft leveling. The commercially supplied valves gave leveling accurate to $\pm 12\frac{1}{2}$ degrees. It was necessary to reduce that variation to ± 2 degrees before the engineers would consider the system acceptable.

• **Reducing Seal Friction**—Seal drag on the spool was reduced by using a wiping lip seal, installed with the lip facing out. Drag was further reduced by maintaining a bath of oil behind the lip seal, and allowing a slight leak past the seal.

To reduce the effects of backpressure on the valves, port and land combinations were altered to give an absolutely symmetrical valve design. Spool clearances were increased to give a controlled leakage past the spool ends of .03 to .05 gpm at 1000 psi. This leakage which drains back to the tank is sufficient to float the valve spool and reduce shifting force to 5 lbs regardless of line backpressure or cylinder operating pressure.

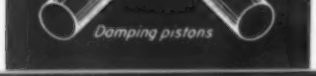
With so little friction, centering the spool required only a light spring. However, a weak spring would not close the valve when operating with the leveling pendulum, or it would pass center and cause over-correction. Designers found that a spring with a 12 lb. force gave the best results.

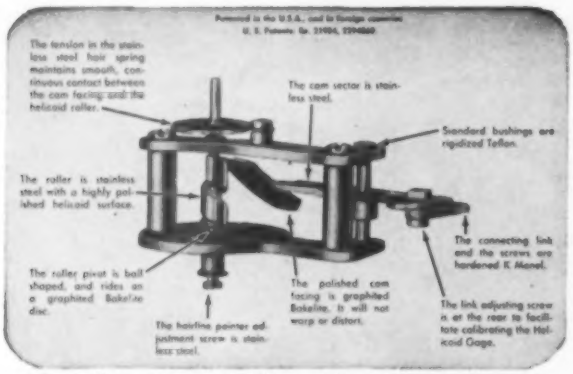
• **Valve Spool Design**—To further increase the valve's accuracy and assure quick response, the spools and lands were recut so that each land was within .0012 in. of its theoretical position. Valve shifting distance was greatly reduced.

To maintain accuracy of $\pm .0012$ in. land location, all six grooves were milled in the valve body at one time. It was necessary to design a special milling machine for this purpose.

Total valve shift in either direction is held to .025 in. from center to full open. This small movement prevents overcontrol from the momentum of the 100-lb. pendulum.

Pendulum thrust at a $2\frac{1}{2}$-degree out-of-level angle

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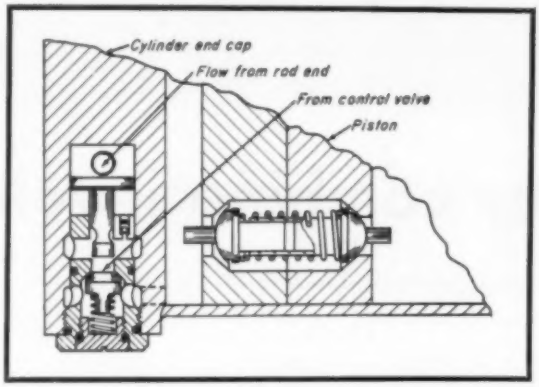
VALVE DESIGN FOR COMBINE LEVELING

is only 11 lbs. However, vibration of the combine induces a small movement of the pendulum. This gives a *live* action, in which pendulum inertia moves the valve. When the combine is stopped, it levels itself. This is due to the pendulum hanging back so that the combine levels before the valve closes.

• **Damping the Pendulum**—A method of damping the pendulum was needed to prevent the combine from swaying on uneven ground because of pendulum momentum which caused overcorrection.

Design of the pendulum dampener was revised several times. The first dampeners were tight at the start and didn't develop oscillating vibrations easily, but after the combine was used, the joints became too loose. Performance was poor because of the small (¾-in.) movement of the lower end of the pendulum and because of difficulty maintaining control valve sensitivity.



CHECK VALVES built into pistons of the leveling cylinders allow flow to pass through the cylinders at the extreme ends of their stroke. A stem extending from the poppet hits the end cap and unseats the valve when the cylinder extends or retracts fully.

Pilot check valves built into the cylinder end cap prevent the mechanism from tilting if fluid flow to the cylinder is interrupted by a line breaking or being disconnected. Pump pressure holds the valves open while the cylinders extend and retract.

The final design uses an oil-bath dampener consisting of four, 2 31/32-in. diameter pistons sliding in a 3-in. diameter cylinder. The pistons connect to a slotted drive member which fits over a stud on the bottom of the pendulum weight as shown in the diagram. The pistons are large enough to move considerable oil with very little movement, and their clearance is great enough to retain sensitivity of the pendulum.

• **Leveling Cylinder Design**—The pistons in the leveling cylinders have integral check valves as shown in the diagram. They bypass pump output when the cylinders are either fully retracted or extended. When the piston is at the extreme end of its stroke, a stem extension attached to the check valve poppet opens the valve allowing flow through the piston. The pump unloads through the piston and prevents overheating when operating the combine at its limit of leveling. ▼▼▼

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1 HP	10,000 PSI	PF 9000 .037 cu. in.* per rev.	VR 9101	VD 4103 (0-3 gpm)	
5 HP	3000 PSI	PF 3003 (2.6 gpm) PF 3006 (4.1 gpm)	VR 9103 VR 3108	VD 4103 (0-3 gpm) VM 6106 (0-8 gpm) VM 6506 (0-10 gpm)	
	4000 PSI	PF 4004 (2.1 gpm)**	VR 9103 VR 3108	VD 4103 (0-3 gpm) VM 6106 (0-8 gpm) VM 6506 (0-10 gpm)	
15 HP	3000 PSI	PF 3008 (5.7 gpm)	VR 3108 VA 3130	VM 6106 (0-8 gpm) VM 6506 (0-10 gpm)	
	6000 PSI	PF 6006 (4.2 gpm)	VR 6108 VA 6130	VM 6106 (0-8 gpm) VM 6506 (0-10 gpm)	
30 HP	3000 PSI	PF 3016 (10.9 gpm)	VA 3130	VM 6520 (0-30 gpm)	
	6000 PSI	PF 6011 (7.9 gpm)	VA 6130	VM 6506 (0-10 gpm) VM 6520 (0-30 gpm)	MF 6011 (12.5)
45 HP	3000 PSI	PF 3021 (14.7 gpm) PV 3021 (0-14.7 gpm)	VA 3130	VM 6520 (0-30 gpm)	MF 3021 (30.3)
	6000 PSI	PF 6015 (10.5 gpm) PV 6015 (0-10.5 gpm)	VA 6130	VM 6520 (0-30 gpm)	MF 6015 (18.2)
90 HP	3000 PSI	PF 3046 (31.4 gpm) PV 3046 (0-31.4 gpm)	VA 3130 VA 6130	VM 6520 (0-30 gpm) (2 bank)	
	6000 PSI	PF 6033 (22.7 gpm) PV 6033 (0-22.7 gpm)	VA 6130	VM 6520 (0-30 gpm)	

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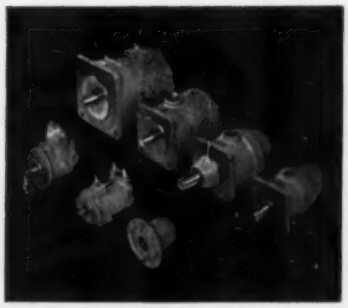

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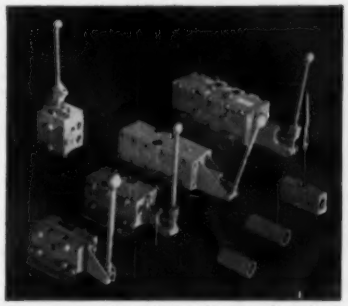
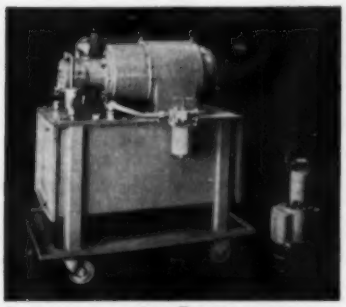


Dynex complete line of control valves with advanced concepts in design offer greater versatility and system economy.

Dynex now offers a new line of top performance, high quality cylinders with precision bores, chrome rods and wipers.



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September 1960

AIRCRAFT SECTION

MISSILES • SPACE VEHICLES • GROUND SUPPORT

RING-SPRING DESIGN FOR HIGH PERFORMANCE METAL STATIC SEALS 122

Various types of metal seals are used in high temperature systems. Ring-spring seals do not have to be held to precise flatness nor fine surface finish. They continue to seal even with gland deflection. Various configurations are shown and design formulas are given.

USING SERVOVALVES IN STRUCTURAL TESTING 128

By Thomas W. Thompson and Kenneth S. Knapton, Jr.

Ever higher speeds of aircraft and missiles produce rapid changes in airframe structural loading. This increases need for more accurate and rapid load simulation in the structural test laboratory. Servovalves accurately vary a programmed oil flow to cylinders simulating variable forces on the airframe.

AVIATION NEWS FROM THE FLUID POWER FIELD 132

AIRCRAFT COMPONENT DATA 134

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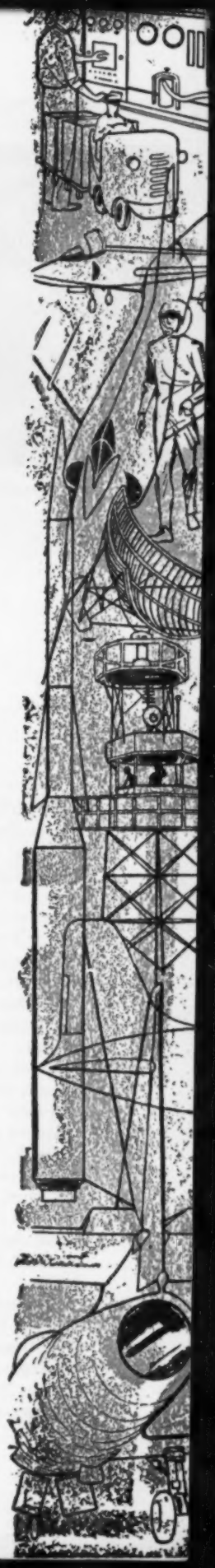

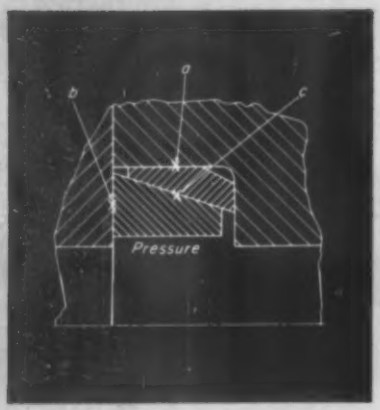

FIG. 1. RING-SPRING STATIC SEAL DESIGN.

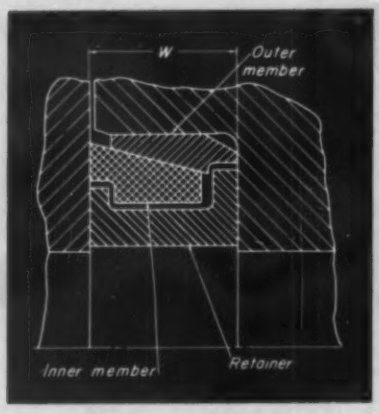

FIG. 2. RING-SPRING SEAL WITH STEP FOR RETAINING INNER MEMBER.

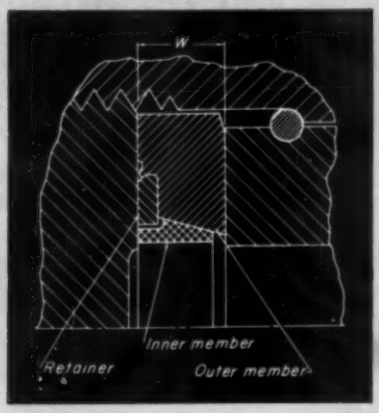

FIG. 3. RING-SPRING SEAL DESIGN WITH LARGE CROSS-SECTION OUTER MEMBER AND NO GLAND.

Ring-spring design for high

● By **JOHN W. HULL** *Research Engineer, Boeing Airplane Company, Seattle, Wash.*

IF AIRCRAFT hydraulic system components and fluids can be made to operate for reasonably long periods at 700-800 F, the need for cooling in high-performance vehicles will be minimized. This will mean greater reliability, easier servicing, and lower weight for the overall system.

Development of mineral-based and synthetic fluids for this temperature range seems to be at the point of success. But, with components such as seals, the highest long-term operating temperature of known and projected elastomers is in the 500-550 F range, and even there, many serious problems still must be solved. As a result, attention has turned to designs of metal alloys, some of which offer excellent high temperature possibilities.

A number of metal seals, including V-ring, bellows, and O-ring types, are being used with some success in high-temperature systems. But they have drawbacks: they are all face sealing, and depend on a precise degree of axial compression at installation for effective sealing; they are sensitive to type and degree of mating component surface finish; and will tolerate very little axial deflection of these components in service.

These factors result in serious limitations on both manufacturing and design, and require components to be designed with a great deal of axial rigidity. In many cases, this adds weight and size to the equipment.

At Boeing we have been working with a static seal configuration adapted from the ring spring, this seal minimizes the defects of other metal seal types. It allows relatively large installed axial deflection of the seal assembly without damage to the members. Furthermore, it offers a somewhat smaller, but still quite large, axial restoring deflection that insures an effective fluid seal even when the gland faces are separated significantly by the pressurizing medium. This is partly due to the high deflection of the assembly at installation, and partly to the fact that the fluid pressure works to make the seal more effective.

Ring-spring seals of small diameter will not tolerate as much gland deflection as larger ones. But this is almost always true for smaller glands, regardless of seal type. With ring-spring seals, the gland surfaces usually do not have to be held to extremely precise flatness and surface finish tolerance, because the relatively high unit bearing load at the sealing face insures a good degree of surface conformity.

Numerous laboratory tests of high-temperature components have shown that ring spring static seals give excellent results at temperatures from —65 to 700 F, with cycling pressures of 0 to 4000 psi, and surges to 6000 psi.

They have sealed well under conditions of gland deflection that caused metallic O-ring and bellows type seals to leak or collapse, in

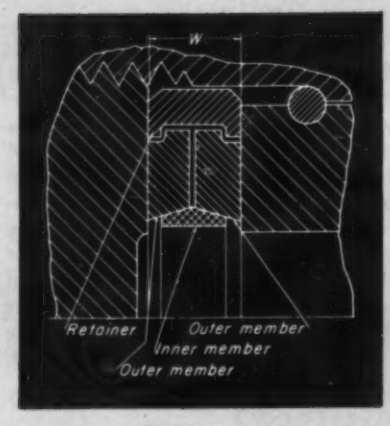

FIG. 4. RING-SPRING SEAL WITH TWO OPPOSED OUTER MEMBERS.

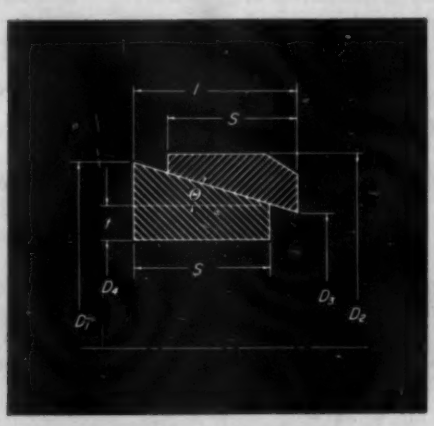

FIG. 5. TYPICAL SEAL ASSEMBLY IN UNINSTALLED POSITION.

performance metal static seals

high-temperature pumps, filters, and actuators.

Sealing Action

The ring-spring seal consists of two members similar to the inner (male) and outer (female) elements of a ring spring, nested together and axially compressed in a groove (Figure 1).

The cross-section area of the the male member is significantly larger that that of the female. Thus, when the inner member is radially compressed at installation, it will push out against the outer member, causing it (the outer member) to stretch and effect a seal against the diametral surface of the groove at *a*.

A second seal is effected between the face of the inner member and the face of the mating component part at *b*.

A third seal is effected between the nesting tapered surfaces of inner and outer members at *c*.

Added to these, is the augmentation of the contact pressure at all sealing points by the pressure of the fluid medium.

The seal shown in Figure 1 is designed to contain internal pressure; but by reversing the geometry of the members and the groove, the same configuration can be used to exclude external pressure.

Because of its simple shape, the seal poses few manufacturing problems with most materials. Simple grinding or lapping suffices for the sealing surfaces. Investment casting, hot forging, or coining will effect material and machining economies for rough and semi-finish stages.

However, the use of two seal members does introduce the possibility of improper assembly by unskilled personnel, and the loss of pieces in storage and handling. Therefore, a number of assemblies have been studied with the seal members contained in factory-assembled capsules, as shown in Figures 2, 3 and 4.

Table 1—Width of Gland Groove vs. Gland Diameter

Gland dia. - D	W
to .50	.04
.51 to .75	.05
.76 to 1.00	.06*
1.01 to 1.50	.07
1.51 to 2.00	.08*
2.01 to 3.00	.09*
3.01 to 5.00	.10*
5.01 to 8.00	.11

*Checked in laboratory tests

In Figure 2, the basic seal members are virtually the same as those shown in Figure 1, and the design calculation remains the same except for an area allowance for the small retaining step. The two seal members are installed over an internal retainer in the form of either a split ring snapped in place

DESIGNING A RING-SPRING SEAL

In considering the detail design of a ring-spring seal, Figure 5, we may assume that the inner seal member will be yielded slightly at installation in the smaller sizes, and that a hoop compressive stress of .005 in./in. of seal diameter is used—a 0.5% unit strain. The compressive stress is then 150,000 psi (0.5% x Youngs modulus of 30,000,000 psi).

Based on this, the axial force required to compress the seal will be:

$$F_a = \frac{2AfEK'}{\tan \theta}$$

where: F_a = axial force required to compress seal, lb
f = hoop compressive strain, .005 in./in. of gland dia.
E = Youngs modulus, 30,000,000 psi
A = cross-sectional area of inner seal member, in.^{2}

$$K' = \left(\frac{u + \tan \theta}{1 - \mu \tan} \right) \tan \theta$$

θ = taper angle of conical surfaces
μ = friction coefficient (dry static coulomb)

Substituting for K′ and simplifying:

$$F_a = AE\ 2f \left(\frac{\mu + \tan \theta}{1 - \mu \tan \theta} \right) \qquad (1)$$

This will be the axial force required to effect a proper installation. This axial force can be minimized by keeping the cross-sectional area *A* of the inner member as small as practical and by the use of as small a taper angle θ as possible. But the angle must be made large enough so that its tangent is greater than the friction coefficient or the inner seal will not exert any axial force against the gland in relaxation.

The restoring force F_r can be computed as follows:

$$F_r = \frac{2AfEK''}{\tan \theta}$$

where: $$K'' = \left(\frac{\tan \theta - \mu}{1 + \mu \tan \theta} \right) \tan \theta$$

Substituting for K'' and simplifying:

$$F_r = 2AfE \left(\frac{\tan \theta - \mu}{1 + \mu \tan \theta} \right) \qquad (2)$$

Equation (2) shows that as μ approaches tan θ in value, the magnitude of F_r approaches zero, reaching zero when $\mu = \tan \theta$. Experience has shown that with most material combinations, a taper angle θ, of 20 degrees will suffice, and for some combinations, such as type 416 stainless steel at Rockwell C 38-42 vs. Rex AAA (T4) tool steel at R/C 63, a taper angle as low as 15 degrees can be used.

The axial movement of the seal inner member, assuming no outward deflection of the outer member and a hoop compressive stress f = .005D for the inner member, can be computed as follows:

$$d' = \frac{fD \cot \theta}{2} \qquad (3)$$

where: d′ = axial component of inner member radial deflection due to installation

The cross-sectional area of the outer member is significantly smaller than the cross-sectional area of the inner member, and its outer diameter is contained by the seal gland. Therefore it is not necessary to compute the stresses in this member. For determining tolerances an assumption can be made that the outer member expands on the average, .001 in./in. of gland diameter to make contact with the gland bore. This induces an additional effective axial movement to the inner member, at installation, of:

$$d'' = \frac{.001D \cot \theta}{2} \qquad (4)$$

where: d″ = axial component of radiol deflection of the outer member due to installation.

The total axial deflection of the seal at installation will be $d = d' + d''$. Substituting equations (3) and (4), inserting the value .005 for f, and simplifying:

$$d = \frac{.003\ D}{\tan \theta} \qquad (5)$$

So far, little has been said about the cross-sectional area of the two seal members except that the area of the inner member must be significantly larger than that of the outer member and should be as small as can be practically manufactured. Fig. 5 shows a typical seal assembly in its free or un-installed position. The diameters D_1 and D_2 are both made .001 D inches smaller than the nominal dimension of the gland bore, and the free length l is made so that:

$$l = w + d \qquad (6)$$

where: w = the width of the gland groove

The width w has been established in laboratory tests of a number of seals and may be selected from the chart in Table 1. Those sizes marked with an asterisk have been checked in the laboratory.

Diameter D_3 can be computed from the following:

$$D_3 = D_2 - 2l \tan \theta \qquad (7)$$

The cross-sectional area of the outer seal member is:

$$A_o = \frac{s^2 \tan \theta}{2} + s \tan \theta\ (l - s) \qquad (8)$$

The cross-sectional area of the inner seal member is:

$$A = \frac{s^2 \tan \theta}{2} + st \qquad (9)$$

where: s = w — .01 (.01 is an arbitrarily-selected axial clearance.)

Laboratory tests have shown that the inner member cross-sectional area A should be 50% greater than the

or a continuous machined ring, swaged or coined over after the seal members are inserted. With this configuration, the gland width need not be held to a close tolerance, because the inner member acts as a spacer to determine the installed dimensions.

The design shown in Figure 3 dispenses with the gland and uses an outer seal member with a cross-section area sufficiently larger to retain the fluid pressure without excessive deflection. A small washer, brazed, pressed or riveted in place, retains the inner seal member. The outer member also acts as the gland width spacer.

outer member cross-sectional Area A_o, so $A = 1.5\ A_o$. Substituting equation (8) for A_o and equation (9) for A:

$$\left(\frac{s^2 \tan\theta}{2}\right) + st = 1.5\left[\frac{s^2 \tan\theta}{2} + s \tan\theta\,(l - s)\right]$$

$$st = \frac{.5\ s^2 \tan\theta}{2} + 1.5\ s \tan\theta\,(l\text{-}s)$$

$$t = \tan\theta\left[\frac{w - .01}{4} + 1.5\ (d + .01)\right] \quad (10)$$

To determine the actual cross-sectional area of the inner member, equation (9) may be rewritten, remembering that $s = w - .01$, as:

$$A = \frac{(w - .01)^2 \tan\theta}{2} + (w - .01)\ \tan\theta \left[\frac{W - .01}{4} + 1.5\ (d + .01)\right]$$

Eliminating the intermediate steps, this simplifies to:

$$A = .75\ (w - .01)\ \tan\theta\ (w + 2d + .01) \quad (11)$$

The inside diameter of the inner member is:

$$D_4 = D_1 - 2(s \tan\theta + t) \quad (12)$$

From the preceding calculations, all of the critical dimensions for a seal of this type can be computed.

For a seal dispensing with the gland, such as shown in Fig. 3, the diametral deflection should not exceed f/ 3 and the average depth x of the outer member can be computed as follows:

$$x = \frac{PD}{2S_b}$$

where: P = pressure in lb/in^2

$$S_b = \frac{fE}{3}$$

$$x = \frac{3\ PD}{2\ fE} \quad (13)$$

The axial component of deflection, d'', of the outer member due to installation can be assumed to be zero, and the total axial deflection d of the seal inner member due to installation in this configuration will be:

$$d = d' = \frac{fD}{2 \tan\theta}$$

The installation and relaxation forces are computed in the manner shown previously.

In the case shown in Figure 4, where two opposed outer seal members are used and the gland is omitted, the installed axial deflection of the seal assembly will be double that of the seal shown in Figure 3, or

$$d = \frac{fD}{\tan\theta}.$$

Table 2—Recommended Tolerances for Seals and Glands

	DIMENSION D-IN.		
Dimension	0 to 1.50	1.51 to 3.00	3.00 & Up
D	+.000 −.001	+.0000 −.0015	+.000 −.002
D_1	+.001 −.000	+.0015 −.0000	+.002 −.000
D_2	+.001 −.000	+.0015 −.0000	+.002 −.000
D_3	+.000 −.001	+.0000 −.0015	+.000 −.002
D_4	±.003	±.005	±.007
w	+.000 −.001	+.0000 −.0015	+.000 −.002
s	±.003	±.005	±.007
θ	±0° 30'	±0° 30'	±0° 30'

Table 3—Recommended Surface Finishes for Seals and Glands

SURFACE	FINISH— Micro-Inches	FLATNESS— Helium Light Bands	METHOD
Gland bore	32		Tool
D_2	16		Grind
D_4	63		Tool
Conical surfaces	32		Grind
Seal face, inner	8	8	Lap
Seal face, outer	32	20	Tool
Counterbore face	63	20	Tool
Flat gland face	32	20	Tool

The design shown in Figure 4 is the same as that in Figure 3, except that two opposed outer seal members are used, to allow for additional axial deflection of the seal cavity due to fluid pressure. A configuration like this can be used to advantage in the very small seal sizes.

The combinations discussed here are just a few of the many that are possible, based on this general concept.

Most of the seals tested at Boeing were of the Figure 1 type, consisting of two members without a retainer. However, several assemblies similar to Figure 2, employing an

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Table 4—Successful Combinations of Materials (At 700 F, 4000 Psi, and Surges to 6000 Psi)

GLAND FACE	OUTER SEAL MEMBER	INNER SEAL MEMBER
Nitralloy, R/C 68+	416 St.St, R/C 38	T4 Tool St, R/C 61
M2 Tool St, R/C 62	410 St.St, R/C 38	T4 Tool St, R/C 61
440F St.St, R/C 42	T4 Tool St, R/C 61	T4 Tool St, R/C 61
SAE 4340 St, R/C 42	T4 Tool St, R/C 61	440F St, St, R/C 42
Nitralloy, R/C 38	T4 Tool St, R/C 61	416 St, St, R/C 38

internal retainer, were also tested. Installation in the latter case was simple, and in the former not difficult, though care was necessary to avoid cocking. The seals are simple and inexpensive to manufacture, and there has been little trouble in holding the necessary tolerances.

In the configurations shown in Figures 3 and 4, the user will not have to supply special grooves or glands for installation. The seals are self-limiting as to gland width, and will function satisfactorily between two moderately flat surfaces which can be produced by inexpensive machining. This eliminates the need for precise counterbores or face grooves; all that is needed is a means of bringing the gland faces together with sufficient force to deflect the inner seal member fully.

Tolerances

The installation and sealing forces and the detail designs discussed in this article are based on nominal seal dimensions. The chart in Table 2 shows the tolerances recommended for the seals and glands.

These tolerances are all selected so that deviation from the nominal will act in favor of greater axial deflection at installation. In all cases, the relaxation of the spring will remain almost constant, because the inner member is yielded at installation.

Surface Finishes

Fine surface finishes are important for good sealing. As a general guide, the surface finishes called out on Table 3 should suffice. However, if both mating surfaces on the face seal are hardened in the neighborhood of 60 Rockwell C, they should both be lapped to 8 micro-inches RMS with a flatness limit of eight helium light bands.

Materials

Materials for both seal members will depend on the temperature range in which the seal is to be used. Materials with similar coefficients of thermal expansion are best, but this is not mandatory if the difference between the coefficients is not too great.

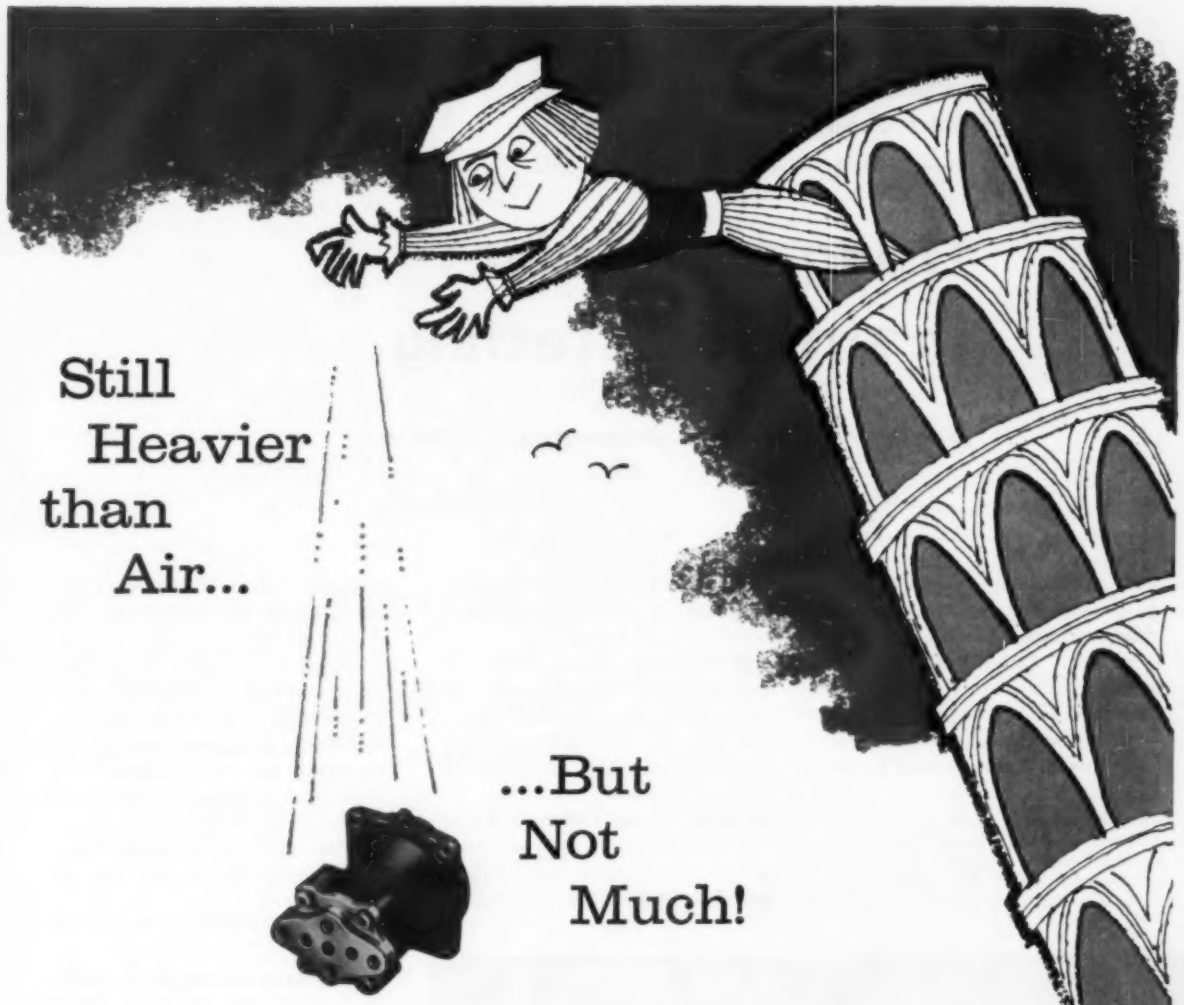
Good resistance to galling is essential to insure leak-free operation.

Table 4 shows material combinations that have proven successful at temperatures up to 700 F with system pressures of 4000 psi and surges to 6000 psi.

For higher temperatures, some of the currently available super alloys, such as Inconel-X, A-286, hot work tool and die steels, and the Udimets, will probably perform satisfactorily.

Actually, until seals are required for temperatures above 1500-1700 F, there is a broad range of materials to choose from, with manufacturing considerations playing a major factor in their selection.

While the ring spring static seals are not a panacea for all fluid retention ills, we feel that they will be of value to the aircraft and component manufacturers in overcoming some of the problems encountered with currently used metal static seals. ▼▼▼



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Qualified engineers in hydraulic and control design are invited to investigate their potential in the STRATOPOWER organization. Please contact Mr. Watkins, Personnel Manager.

One important application of electrohydraulic servovalves is in airframe structural testing. The valve accurately varies a programmed oil flow to a cylinder, simulating variable forces on a missile or aircraft during flight.

Using servovalves in structural testing

• By THOMAS T. THOMPSON, and KENNETH S. KNAPTON, JR.,*

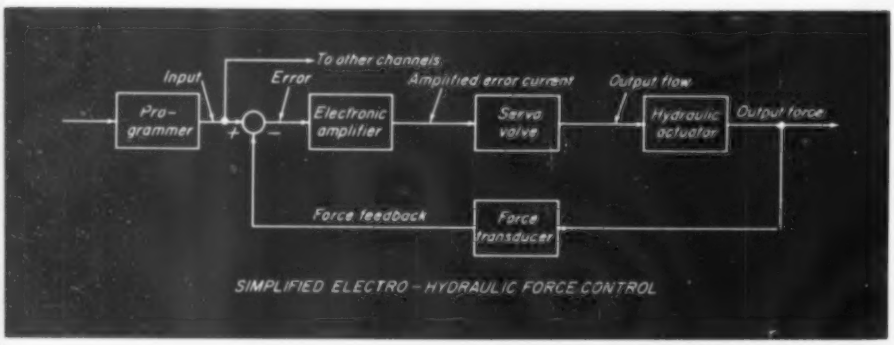
THE closed-loop, electrohydraulic control system applies programmed structural loads to test specimens. A servovalve is the heart of the system. Its output oil flow to the cylinder applies force on the specimen and varies flow according to input current to the valve. Electrical input is programmed for rapid, accurate simulation of flight forces.

A hydraulic force system can apply constant loads to many separate points regardless of deflection. Also, the system can fail safe in case of specimen, electronic, or hydraulic failure.

• **Error Signal Controls Valve**—In a closed-loop, servovalve control system output from a programmer feeds into each operating channel. The amplified error signal controls the servovalve. Oil flow from the servovalve is proportional to amplifier output. The oil operates a hydraulic actuator which applies force on the test specimen. A force transducer measures the output force and feeds back a voltage proportional to the force. When voltage from the force transducer equals input voltage from the programmer, er-

Continued on page 130

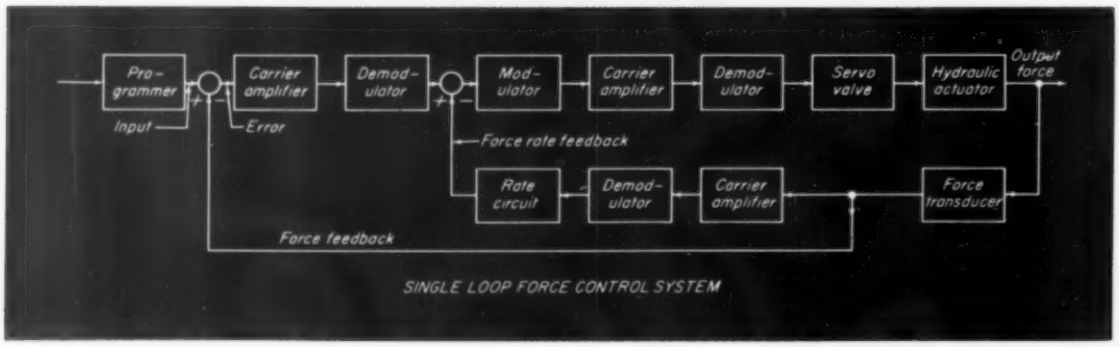
*Mr. Thompson was Senior Systems Engineer and Mr. Knapton was Applications Engineer at Sanders Associates, Inc., Nashua, New Hampshire, when this article was written.



SIMPLIFIED ELECTRO-HYDRAULIC FORCE CONTROL

FAST SYSTEM RESPONSE is desirable in a spring-mass load, force control system. Fast response, however, produces system instability: the load oscillates in position and force.

TO OVERCOME INSTABILITY a more complex system is needed. One method involves rate-of-change feedback. A force rate of change signal is subtracted from the amplifier error signal. The rate signal opposes and reduces rapidly changing output signals. This modulates oil flow to the hydraulic actuator.



SINGLE LOOP FORCE CONTROL SYSTEM

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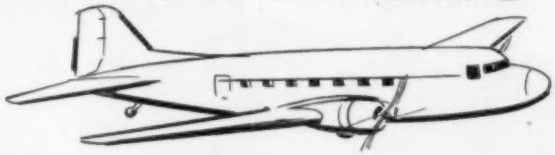
FLUID POWER SYSTEMS



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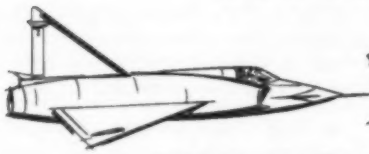

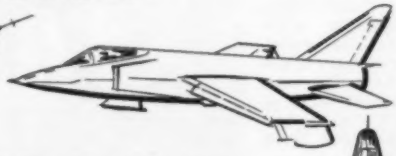

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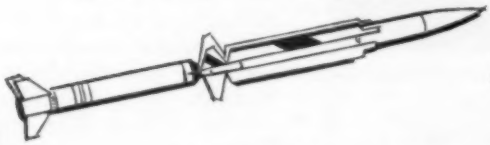
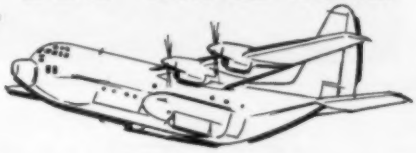
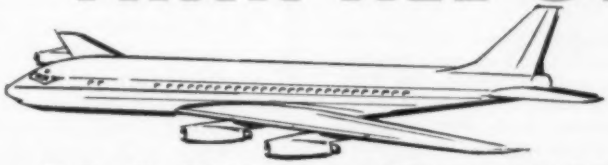
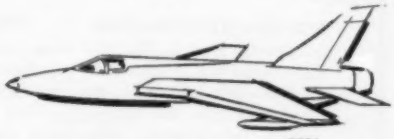




APPLICATIONS

THAN ALL OTHER





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MAKES COMBINED

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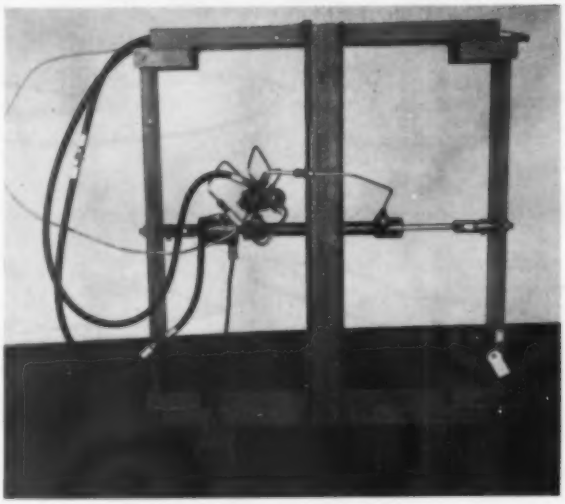
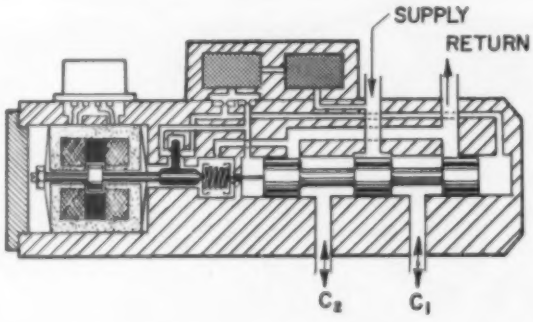


BREAD-BOARD SET-UP of force control systems for structural tests. The components include a double-acting hydraulic cylinder, servovalve, and force transducer. The larger cylinder is 10 sq. in. and the smaller is ½ sq. in.



SERVOVALVE OPERATION: Input differential current is converted into a magnetic force on the first stage armature. This force moves the first stage armature transversely, displacing a baffle between two fixed nozzles which have a constant pressure oil supply. As the baffle moves, pressure at one nozzle increases and pressure at the other nozzle decreases. This pressure differential, applied to the ends of the output control piston, moves it. Since the output control piston is essentially a 4-way spool-and-sleeve valve, output oil flow is proportional to the displacement of this piston.

The servovalve has internal feedback. The output piston displacement is transmitted through a feedback spring as a nulling force on the first stage armature. When the feedback force and the input magnetic force are equal and opposite, the output control piston holds stationary, and input oil flow is proportional to the input signal.

Courtesy Sanders Associates, Inc.

ror is zero, and the required force is accurately maintained on the specimen.

• **Bread-Board Set-Ups**—Much work has been done to develop complete, rapid-loading structural test systems. Typical laboratory, bread-board set-ups of actuators, force transducers, servovalves, and simulated spring-mass loads are shown. They have been used with bread-board amplifiers to test effects of varying actuator sizes and specimen spring constants.

In these bread-board set-ups, the servovalve produces an oil flow proportional to the error signal and the speed of the actuator is proportional to flow. Therefore, actuator speed is proportional to error signal. In other words, the position of the actuator is proportional to the integral of the error signal. With the integrating device in the system, zero error results for any position of the actuator. This gives zero load droop.

• **Fail Safe Circuit**—To prevent the force servo system from damaging the test specimen, a fail safe circuit is in the system. The fail safe circuit senses abnormal motion of the test specimen. This could be caused by electronic or hydraulic power failure, sudden velocity or acceleration of the test system and excessive output force.

In an emergency, the simplest, most reliable fail safe circuit eliminates hydraulic pressure to the servovalves and connects them to return pressure. A 4-way, solenoid-operated, spring-return valve is in the hydraulic fluid supply to all servovalves. This fail safe valve is energized for normal operation. During malfunctions, interlocking switches and detector devices deenergize the valve. Servovalve hydraulic pressure is removed and valve supply ports are connected to return. Then the natural spring force or weight of the test specimen returns the hydraulic actuator at a controlled rate to equilibrium.

Electrohydraulic methods of programming hydraulic loads can be expected to increase in most fields of structural testing and will result in safer and more reliable components and systems. ▼▼▼

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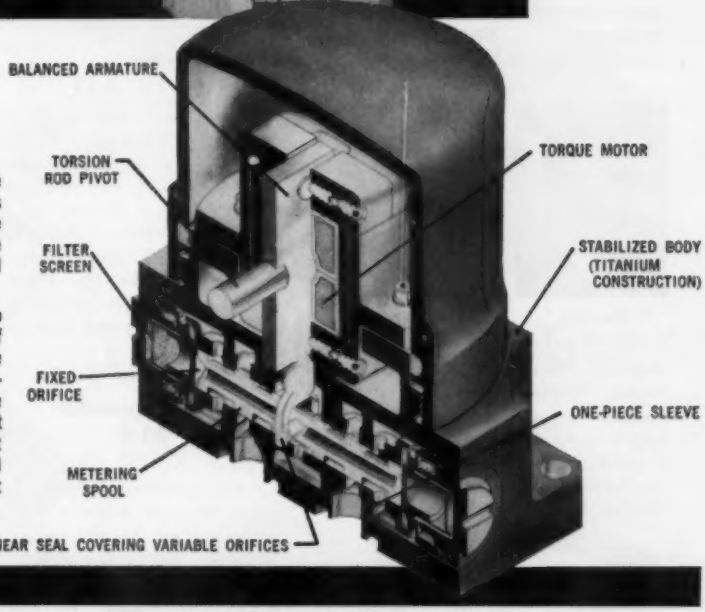
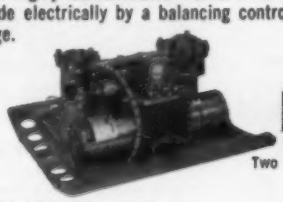
Hydromechanical unity feedback relates spool position to torque motor armature position and also nulls out effects of orifice variations due to supply pressure and temperature fluctuations. Flow force reactions are thus substantially reduced and hydraulic centering of pilot position is feasible without spring hysteresis and null shift. Large orifices prevent clogging and silting and high shear forces permit efficient operation even with highly contaminated fluids. Final null adjustments are made electrically by a balancing control at amplifier output stage.





Integrated Control Module Includes Kearfott's Electrohydraulic Servo Valve, Two Rotary Output Shafts, Geared Pump and Pressurized Sump.

TYPICAL CHARACTERISTICS

	Medium Flow (#6103-#6106)	High Flow (#6104)
Rated flow	to 7.5 gpm at 3000 psi valve pressure drop	to 18.0 gpm at 3000 psi valve pressure drop
Hysteresis	3% maximum total rated current	3% maximum total rated current
Supply pressure	300 to 3000 psi	300 to 4000 psi
Proof pressure	4500 psi pressure port 3000 psi return port	6000 psi pressure port 3000 psi return port
Pressure gain	First stage—500 psi per ma minimum with 3000 psi supply	First stage—500 psi per ma minimum with 3000 psi supply
Load pressure gain	8500 psi per ma minimum with 3000 psi supply	10,000 psi per ma minimum with 3000 psi supply
Temperature	−65°F to +275°F	−65°F to +275°F

	Medium Flow (#6103-#6106)	High Flow (#6104)
Maximum Null Shift Temperature Change per 100°F	(% of rated current) 1%	1%
Supply Pressure Variation ±	2%	2%
Quiescent Current Change 20%	1%	1%
Weight	12 ounces	16 ounces

TORQUE MOTOR: Note: 6103 & 6106 identical with exception of torque motor characteristics.

	Valve #6103	Valve #6106
Input Power	300 Milliwatts	64 Milliwatts
Rated Current	± 10 ma	± 8 ma
DC Coil Resistance (other motors also available)	3000 ohms/coil	1000 ohms/coil

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AVIATION NEWS

from the fluid power field

Vickers Aero appoints Duncan and Ryberg

T. N. Duncan has been named manufacturing manager of Aero Hydraulics Div., Vickers, Inc. He joined Vickers in 1948, as a design

Duncan

Ryberg

engineer. He recently managed the Joplin, Missouri plant. John W. Ryberg was appointed application engineer for the division. He was a sales engineer in the Aviation Products Div., Goodyear Tire & Rubber Co., Los Angeles.

Aerotest announces association with Technik

Aerotest Laboratories, Inc., Deer Park, N. Y., specialists in testing of hydraulic, pneumatic, mechanical, and electronic systems announces an affiliation with Technik, Inc., Garden City, N. Y. The new association will provide advanced research and development facilties for Aerotest.

Ratajski joins Kearfott

Kearfott Division, General Precision, Inc., has announced that Z.R.S. Ratajski, who has 20 years of experience in instrument component design in the U.S. and Europe, has joined Kearfott as chief of research and advanced development, Precision Components Division. He was engaged in research and development on precision aircraft components for 17 years with the Royal Aircraft Establishment in England.

Hadbar parts approved for X-15

O-rings and other molded parts of Hadbar 8000-71 Viton compound have been approved for critical areas of the hydrogen peroxide oxidizer system of North American Aviation's X-15. Because of its extremely low activity in hydrogen peroxide, the Viton compound is being used in valves, regulators, couplings and fittings.

Kahn & Co. names sales manager

Kahn & Co., Inc. Hartford, Conn., appointed Edward D. Kane sales manager. Kane was formerly a consultant to the AEC doing work on submarine reactors and the first atomic generating station. He is a member of SAE and AIChE. Before joining Kahn he was divisional sales manager of Cuno Engineering Corp., Meriden, Conn.

Kane

Chattler

Atchley appoints general manager

Leo M. Chattler was named general manager of Raymond Atchley, Inc., a subsidiary of American Brake Shoe Co. Chattler has been in the field of automatic controls for over 20 years. He was associated with Chance Vought Aircraft, and he was head of the actuating and flight controls systems section of the Bureau of Aeronautics. He is chairman of the SAE A-18 Technical Committee (aircraft, missile, and space flight control systems) and a member of the A-6 Committee (aircraft, missile, and space vehicle hydraulic and pneumatic systems).

STRUCTURAL TEST FIXTURE will simulate all stresses encountered by the live Polaris motor during the first 1½ seconds of launching. It will test the first-stage motor, the second-stage motor, or a combination of the two. Twenty actuators will position the simulator for load application. The hydraulically-operated simulator will place loading equipment in any direction desired. Loads are to be set or automatically programmed. The unit will be 35' high and 20' square. Aerojet General granted Rucker the fixture contract.

Leinicke joins R&D staff

McCormick Selph Associates announced that Robert F. Leinicke has joined the R&D technical staff as group leader responsible for the design and development of cool gas generators. In the past Leinicke designed the first full servo, "lock-on", gun director, airborne radar antenna.

The "custom" approach to oil seal manufacture, pioneered by IPC, has resulted in some real off beat products.

None-the-less . . . they *work!* They suit the application *and*, in more cases than not, they have contributed substantially to cost savings.

When you're faced with a rugged problem involving oil seals, what synthetic compound comes to mind? How about case design? . . . friction? . . . torque? . . . shaft speeds?

Oil seals are an engineered product in themselves . . . just as good as their individual design. That's why we think each oil seal application deserves special "custom" thinking. That's why IPC oil seals are noted for performance. Let us show you what IPC can do to relieve your particular problem.

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Circle **1** on Time-Saver Card

Fall Wiper Ring SPRING LOADED

The Fall "CJ"* Wiper-Scraper Ring is Spring-Loaded causing Squeeze-Grip Action on the O.D. of the piston rod during entire cycle. This patented feature maintains a uniform, continuous pressure on the wiping edge of the ring at all times, stopping any buildup of foreign matter between the ring and the rod.

It automatically takes up wear, maintaining NEW RING PERFORMANCE. Available in diameters ½" through 13" for any commercial use. AN and MS numbers in use by the Military and Aviation industry since 1944. Manufactured in accordance with MIL-S-5049. (*Closed Joint)

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Est. 1935

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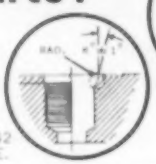
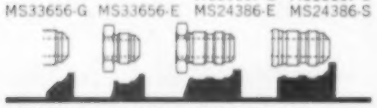
or MS33515

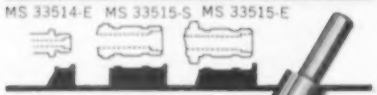


MS 16142
or S.A.E.

MS33657-E MS33657-S
MS33656-G MS33656-E MS24386-E MS24386-S



MS 33514-E MS 33515-S MS 33515-E



Standard cutters in stock for immediate delivery.
Write for catalog.

SONNET Tool and Mfg. Company
580 North Prairie Avenue • Hawthorne, Calif.

Circle **130** on Time-Saver Card

AIRCRAFT COMPONENT DATA

Cartridge Relief Valve . . . precise control of low pressure fluids

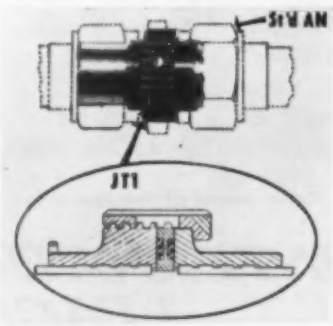
Chatter-free, direct-operating valve has 10 to 500-psi range. Specific pressures covered by three

ranges. Within a range, final adjustment is made by an external, pressure-adjusting screw. This permits field pressure adjustment for particular operating conditions. Weighs 6 oz. Of stainless steel and anodized aluminum. Installed in a single body or a multi-valve manifold, the cartridge simplifies circuitry. Easily removed for servicing without disconnecting lines.—*Fluid Regulators Corp., Painesville, Ohio.*

Circle **500** on Time-Saver Card

Tube Connector . . . 1/5th weight of AN connector

New sealing method assures no leakage under temperature, pressure, and vibration extremes. Can be coupled and uncoupled by hand, no tools necessary. Tubing attached

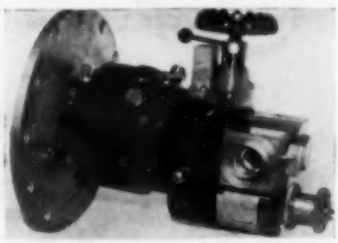


without beading, flaring, or welding. Connection exceeds burst value of tubing. Seal is re-useable. Sizes from ¼" through 2". For temperatures of −70 F to 450 F. Special connectors for extremely low and high temperatures. For most fluids and gases.—*Gamah Corp., Santa Monica, Calif.*

Circle **501** on Time-Saver Card

Axial Piston Pump . . . for GSE

LA 38-9 has integral or panel-mounted compensator. AND 10266 flange, straight shaft and key or



foot mounting. 2.43 cu. in./rev. 1200-4000 rpm. 3000 or 5000-psi operation. Basic unit weighs 37 lb. —*Lucas-Rotax Ltd., Toronto, Ontario Canada.*

Circle **502** on Time-Saver Card

Silicone O-Rings . . . resist swelling

New fluorinated, silicone rubber compound, TH-1057, is highly resistant to swelling normally caused by solvents, jet fuels, and oils. O-rings made from this compound provide an excellent seal for fluids from low temperatures to 450 F. with excellent dry heat resistance. TH-1057 has a Shore hardness of 70-75. By starting with a higher initial hardness, a higher swollen hardness is maintained.—*Stillman Rubber Co., Culver City, Calif.*

Circle **503** on Time-Saver Card

Continued on page 136

SPECIAL DESIGN

PNEUMATIC SYSTEM FOR GROUND SUPPORT

Retriever service — This new Cornelius compressor assembly, Model 3800209, is invaluable for retrieving "downed" aircraft. It is easily flown to any location to provide complete pneumatic service for aircraft of all types.

Military Identification for Model 3800209 — Federal Stock No. 4310-585-8240, Type ACU-2/M, Index No. 0157-2160, meets military specification MIL-C-25989 (USAF).

No other system this size does so much and costs so little!

This new Cornelius pneumatic system is exceptionally small in size but it is capable of providing all the basic functions of much larger and heavier ground support compressor assemblies. It does the work of much larger units at far less initial cost and at lower operation, transporting, storing and shipping costs. Here are 3 good reasons why this system greatly improves the flight line service of airlines and air wings everywhere.

1.) The complete assembly measures only 9.5 cu. ft. (30" x 20" x 27"). Weight: less than 250 pounds. Ideal equipment for airlift operations and retriever service anywhere in the world. One man can easily roll the complete equipment from one location to another. Two men can easily load it into any vehicle.

2.) This complete pneumatic system includes compressor, 4 cycle, 4.7 h.p. gas engine drive, 200 cu. in. air bottle (which holds 25 cu. ft. of free air), adjustable (from 0-3000 psi) pressure regulator delivery valve, automatic moisture dump, chemical drier, relief valves and check valves. It is designed to utilize warm air heaters under arctic operating conditions.

3.) This assembly can be used to service accumulators, actuators, pneumatic system reservoirs, tires, struts, and other miscellaneous pneumatic gear. It provides clean, dry air at regulated pressures to 3000 psi and at volumes of up to 4 cfm free air.

For more detailed information and performance reports on this and other Cornelius compressor assemblies, write or phone:

THE Cornelius COMPANY / *Aero Division* 557-39th Avenue N.E. • Minneapolis 21, Minn.

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YESTERDAY'S PIONEER TODAY'S LEADER

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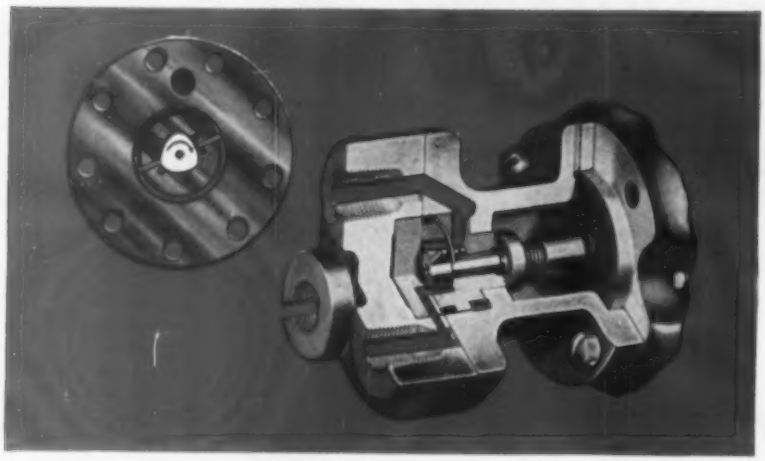
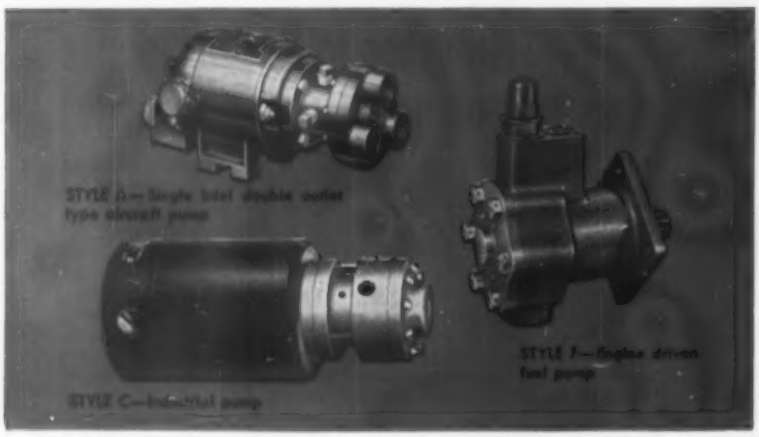
Positive Displacement Rotor Type. For Industrial Applications, Aircraft Anti-Icing and Aircraft Fuel.



IT'S SO SIMPLE!

The rotation of the rotor draws the fluid in through two passages, filling the cavities formed by the three lobes of the rotor. This fluid is sealed within these small cavities until it is forced through the two outlet holes by the floating blades. The flow may be kept uniformly divided through two outlet ports, or may be combined internally for passage through a single port.



STYLE A—Single inlet double outlet type aircraft pump

STYLE F—Engine driven fuel pump

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Send for Weldon Manual and Catalog with detailed specifications and installation drawings, covering the full range of Weldon pumps in various capacities. Specify your requirements.

40 YEARS OF LEADERSHIP SINCE 1918

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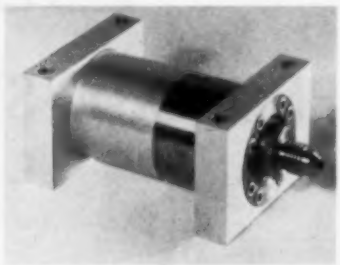
Circle **155** on Time-Saver Card

AIRCRAFT COMPONENT DATA

Pressure Transducer . . . for 5 to 1500 psi

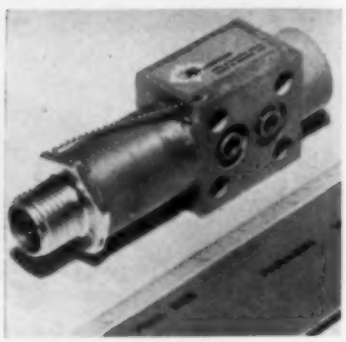
Withstands vibration of 35 G's and 50-2000 cps and has a temperature range of −65 F to 180 F. Combines variable reluctance pressure transducer and a d-c energized carrier-demodulator. Model CP 40 will accept corrosive fluids and gases on both sides, and delivers 0 to 5 vdc. It weighs 18 oz.—*Pace Engineering Co., North Hollywood, Calif.*



Circle **504** on Time-Saver Card

Normally-Closed Valve . . . is explosive-actuated

Model 1014-2 is for liquids or gases. Balanced piston. Insensitive to backpressure. Zero leak. Rated at 4200 psi. For −65 to 160 F continuous, 300 F intermittent. Manifold mounting. 5/32" flow passage. Weighs 2.6 oz.—*Pyronetics, Santa Fe Springs, Calif.*



Circle **505** on Time-Saver Card

New Silicone O-Ring Process . . . maintains tolerances

Now silicone O-rings conform to standard AN and MS drawing dimensions and tolerances. Special

Continued on page 138

Circle **134** on Time-Saver Card

TubeXperience in Action

9 REASONS TO CHOOSE SUPERIOR STAINLESS AIRCRAFT/MISSILE QUALITY TUBING FOR HYDRAULIC SYSTEMS

- Every length hydrostatically tested to recommended working pressure.
- Fully tested to assure flareability without surface notches or breaks.
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- Thoroughly cleaned to insure freedom from oxide film and foreign particles.
- Tolerances closer than generally required by industry specifications.
- Every length, down to 3/16 in. OD, indelibly marked with our name, specification, analysis, heat number and size.
- Certified test reports when required.
- Available in both seamless and Weldrawn® forms in Types 304, 321 and 347 stainless.
- Carried in stock by leading Steel Service Centers in sizes from 3/16 through 1⅛ in. OD.

FREE: "Tips on Stainless for Aircraft Hydraulics." Write Superior Tube Company, 2030 Germantown Ave., Norristown, Pa.

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The big name in small tubing

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All analyses .010 in. to ⅛ in. OD—certain analyses in light walls up to 2½ in. OD

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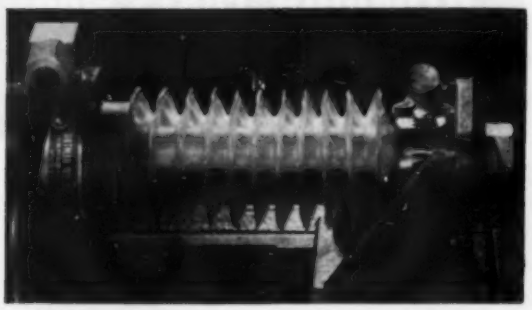
HIGH-FLEX DUST BELLOWS

made of electronically sealed plastic film



Inexpensive dust bellows (boot) seals hermetically against abrasive chips or dust, or against corrosive liquids; high flexibility often permits installing on existing air or hydraulic cylinders without increasing space requirements. Any length desired can be furnished, with price directly proportional to number of convolutions.

Other uses include protection of traverse screws and ball bearing slides. When transparent plastic is used, any oil leakage is trapped and revealed. The boot is recommended for a range of –30° to 210° F and is now available with no tooling charge in a wide range of standard sizes from 1" to 13½" OD. Delivery is usually 1 to 3 weeks. Also made in custom sizes, colors and shapes—in quantities from 1 to 1000. **Write or call for engineering data and detailed recommendations** (no salesman will come)—**A. F. Gagne Associates, 50 Wall St., Binghamton, N.Y., phone RA 3-7519.**

Circle **57** on Time-Saver Card

CIRCLE SEAL

9500 Series

MINIATURE LEAKPROOF SHUTOFF VALVE

LEAKPROOFMANSHIP...a word not found in Webster's but coined to convey our philosophy (and we live up to it, too) of perfect leakproof sealing. Not merely braggadocio but an operational certainty. It is said that the very best things come in small packages and this is especially true of the Circle Seal 9500 Series Valves. Miniaturized at no sacrifice in quality, these valves operate from 0-2000 psi while maintaining all the features that have made the name CIRCLE SEAL synonymous with valve quality.

- **Leakproof in vacuum or pressure service**
- **Straight through flow**
- **Positive position indication**
- **Provides accurate metering**
- **Effortless opening and closing**
- **"O" Ring seals virtually eliminate wear**
- **Convenient 90° "T" handle**

CIRCLE SEAL® *precision valves*

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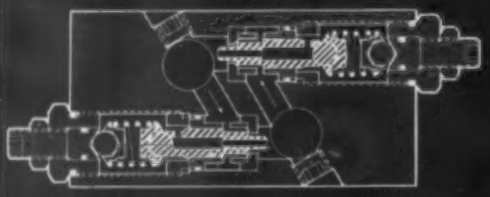
Circle **37** on Time-Saver Card

Circle **53** on Time-Saver Card

Protect Fluid Motors And Double Rod Cylinders



DUAL RELIEF VALVE

- Eliminates shock pressures that system relief valves can not prevent
- Assures smooth starting or stopping
- Rugged design for mobile equipment, machine tools and special machines

• Pressure Adjust Ranges — from 100 to 3000 psi

• For oil — ⅜", ½", ¾" pipe (NPTF)

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Needle Valves • Pilot Check Valves • Special Valves
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AIRCRAFT COMPONENT DATA

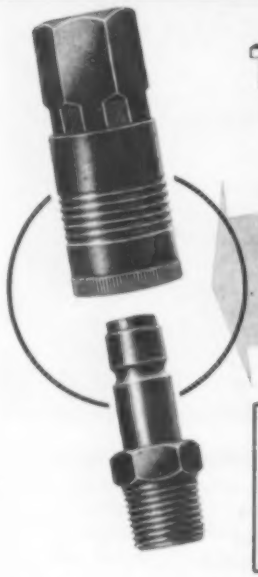
compounding and processing methods produce silicone rings and custom molded parts from molds previously designed for standard parts. Makes possible direct substitution of silicone in applications which previously required special tooling. Silicone compounds, with shrinkage comparable to organic polymers, now meet AMS and MIL specifications in durometer hardness from 50 to 80. Actual test reports on request.—*Plastic and Rubber Products Co., Los Angeles, Calif.*

Circle **506** on Time-Saver Card

Soft-Seated Check Valve . . . positively holds O-Rings

Ingenious new cage device restrains O-rings from washout. Series 200 valve assures reliability against high pressure, split-second, surge flows. Body is heavier, more ruggedly constructed of brass, aluminum, steel, or stainless steel.

TRU-FLATE



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Quick couplers for air, steam, oil, gas, water, oxygen, etc. A broad range available of types and sizes....

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Circle **140** on Time-Saver Card

PROTECT VITAL HYDRAULIC PARTS with *Seal-Guard* METALLIC ROD WIPERS

Bronze, knife-edged rings, mounted in a synthetic rubber cushion ring, remove rust, scale and foreign particles before they can reach vital internal parts. The cushion ring, compressed on assembly, exerts constant pressure on the bronze rings. Rings will not mar the rod, are oil and heat resistant and friction-free. Packing failures are literally "wiped out"!

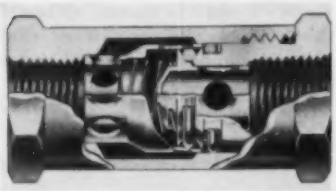
Available in standard sizes for ¼ to 6 inch rod diameters. Larger sizes up to 24½" diameter by special order.

Detailed literature on request

HYDRAULIC ACCESSORIES CO.
24301 Hoover Road Warren, Michigan

Circle **73** on Time-Saver Card

Valve has proper cushioning combined with low pressure drop and dependable, sensitive, leak-free re-

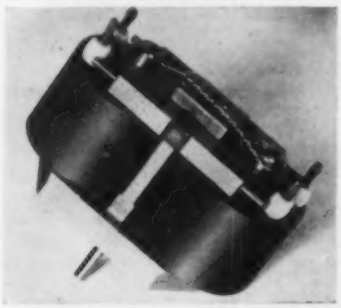


seating. For use in high pressure gas or liquid service with extreme surge flows. Sizes from ⅛" to 2".—*Circle Seal Products Co., Pasadena, Calif.*

Circle **507** on Time-Saver Card

Torque Motor . . . for continuous duty

Electromagnetic, polarized torque motor provides output force and/or motion proportional to input current. To 0.010" linear stroke, 0.017 in-lb torque at 1200



F. Under these conditions, tests show 20-hr operating life, including 7 million output motions. Adapts to fluid power jobs, since output shaft is sealed from motor elements.—*Bendix-Pacific Div., Bendix Corp., North Hollywood, Calif.*

Circle **508** on Time-Saver Card

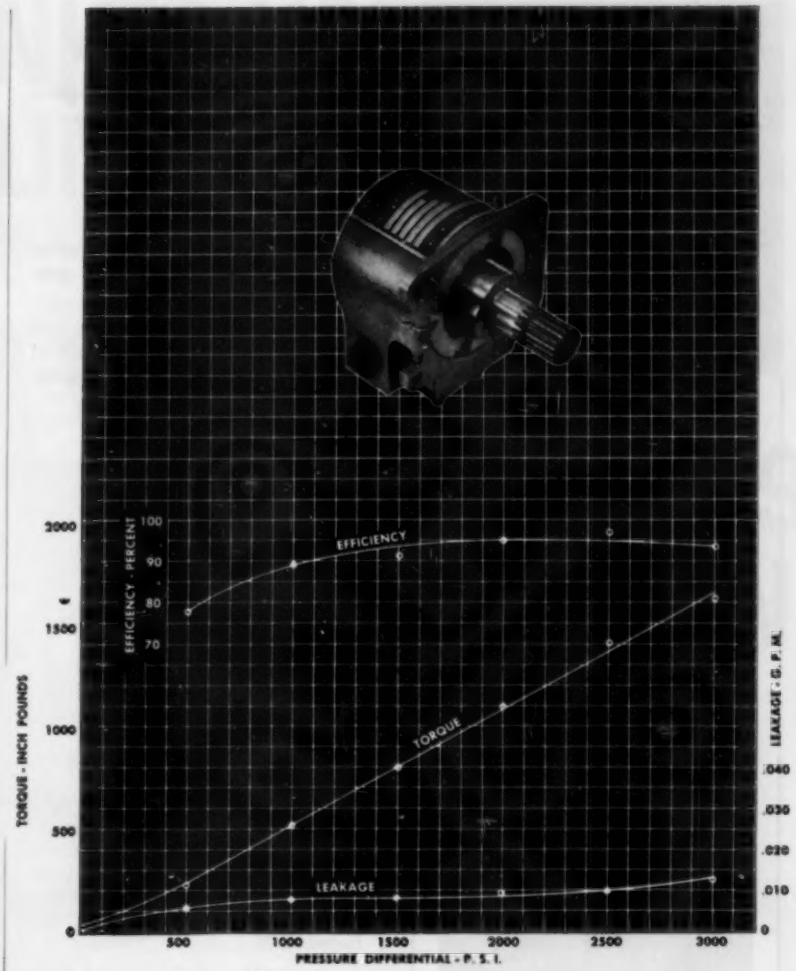
Woven Wire Mesh Filters . . . for fluids and gases

New line of micronic filters available in ratings from 5-micron absolute. Can be supplied in AN

815 fittings as cartridge type elements, as in-line mounted units, and bowl-type cases with or without visual pressure drop indicators and by-pass valves.—*Aqualite Corp., Santa Monica, Calif.*

Circle **509** on Time-Saver Card

Continued on page 140



Reliable positioning of airborne radar controlled by new Houdaille Rotary Actuator

At speeds approaching Mach II, airborne radar must be controlled quickly and precisely. That's why Magnavox incorporated this Houdaille hydraulic ROTARY ACTUATOR in the radar unit they supply for the Chance Vought F8U-2N Crusader.

Like all Houdaille ROTARY ACTUATORS, this one is lightweight and operates at 98% efficiency. Direct rotary motion without mechanical conversion provides accurate positioning.

Close coupling of the actuator saves valuable system weight and space. Minimum backlash, low internal leakage and low friction insure a highly responsive unit.

Output torques available to suit your individual requirements.

Houdaille Industries, Inc.

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545 E. Delavan Ave., Buffalo 11, N. Y.
. . . Specialists in hydraulic damping and vibration control

Send this coupon for engineering bulletins giving performance curves and other data on the new Houdaille Rotary Actuator.

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Circle **27** on Time-Saver Card

NEW
Rubbernek
FLARELESS
FITTING
ABSORBS
VIBRATION

Unique Construction!

Rubbernek absorbs vibration, pulsating pressure surges. Hydrostatic tests prove Rubbernek's seal-tight qualities are maintained at high pressures... withstand test conditions far more severe than those normally encountered in actual service. The cushion unit, comprising five special parts – seal, anchor, guide, retainer and cushion, prevents metal to metal contact of tube and connector.

Rubbernek is factory assembled and gives perfect, foolproof, time-saving installations every time. Rubbernek's special design eliminates torque problems. No flaring or other tube preparation necessary.

Rubbernek
conforms to J. I. C. standards. Can be reconnected repeatedly. Exceeds MIL-F-5506-A requirements.

Chicago Forging invites you to test Rubbernek.

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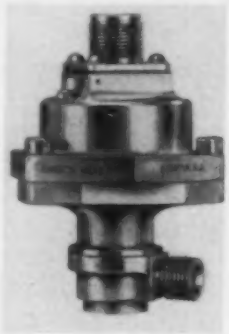
CHICAGO 14, ILLINOIS

Circle **35** on Time-Saver Card

AIRCRAFT COMPONENT DATA

High Temperature Gas Valve . . . controls 2000 F gas

Valve is 2-way, normally-closed, magnetically-operated on 27-35 vdc, model MV-146G. Controls output from small solid-propellant,

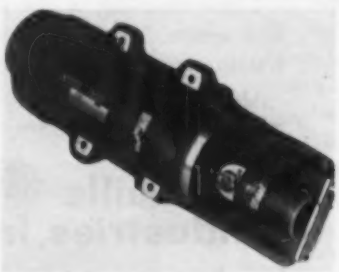


gas generator. Has an adjustable, equivalent sharp edge orifice diameter 0.150" to 0.185" and weighs 9 oz. Dimensions are 3⅜" high, 2⅝" diameter. The position of the input/output fitting can be varied to any angle perpendicular to the valve base.—*Marotta Valve Corp., Boonton, N. J.*

Circle **510** on Time-Saver Card

APU Pump-Motor . . . has silicone heat sink

Compact manifold-type unit drives the main hydraulic system of Polaris missile's 1st and 2nd stages. Thick silicone coating surrounds entire package, permits mounting within inches of rocket blast. Coating is applied and not aged. As temperature rises, the silicone ages and absorbs heat,



protecting internal parts against high temperature. Motor operates on 28-vdc batteries at 11,000 to 20,000 rpm. Low-angle, variable pump has high efficiency and operates on MIL-O-5606 oil with temperatures to 275 F. Operating range varies to meet different loads of the Polaris' 1st or 2nd stage. Assembled and tested under ultra clean conditions, has a guaranteed storability of 5 years.—*Vickers Inc., Detroit, Mich.*

Circle **511** on Time-Saver Card

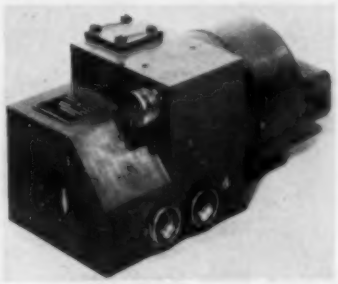
V-Band Couplings . . . for connecting and sealing

On all types of tubing, ducts, containers, and structural devices for aircraft or industrial applications. Coupling sizes in any increment from the minimum diameter of the coupling to the maximum diameter of the application. New, 4-page brochure available with complete design information.—*Aeroquip Corp., Marman Div., Los Angeles, Calif.*

Circle **512** on Time-Saver Card

Servovalve . . . requires low signal power

No need for external electronic or electrical amplification, because of sensitive pilot valve. Pilot fluid positions the main output valve spool to control main fluid flow. Full flow is obtained with 2 milliwatts signal power. Static friction



in the pilot valve is eliminated by applying ½ watt of dither at 400 cps. Mechanical feedback from main valve to torque motor sets up force balance to maintain the valve in the position indicated by the signal. Valve operating pressures from 150 to 4500 psi, with full flows from 0.5 to 50 gpm with 1000-psi drop. Temperatures from −65 F to 450 F. For all hydraulic fluids and most fuels. May be operated with mechanical or electrical signals with outputs as flow, pressure, force, or position. Plug-in filter protects pilot valve from contamination.—*Consolidated Controls Corp., Inglewood, Calif.*

Circle **513** on Time-Saver Card

ANKER-HOLTH CYLINDERS FULFILL RIGID WESTINGHOUSE REQUIREMENTS IN NEW WEAN GEARLESS 'FLYING PRESS'

A new gearless "Flying Press", especially designed and built by Wean Equipment Corporation for Westinghouse Electric Corporation's Standard Control Division at Beaver, Pa., is equipped with Anker-Holth cylinders.

The press operates at twice the production rate of the presses previously used for this operation. It offers reduced die maintenance and permits simplified over-all machine maintenance.

Necessary components in the press are rugged, reliable cylinders for pulling the lower bed out of alignment in event of cobble or mis-feed emergencies. Wean has found that Anker-Holth cylinders fulfill this rigid and exacting requirement.

Chances are, Anker-Holth has the answer to your power cylinder needs, too. You may choose from the world's widest selection of standard models, available in all mountings. Special cylinders can be designed to your exact requirements, usually assembled from a combination of standard parts.

YOU HAVE A BETTER CHANCE OF FINDING THE EXACT POWER CYLINDER YOU NEED IN A STANDARD PRODUCTION MODEL AT ANKER-HOLTH

ANKER HOLTH

DIVISION, THE McDOWELL-WELLMAN COMPANIES
2723 CONNOR STREET, PORT HURON, MICH., U.S.A.

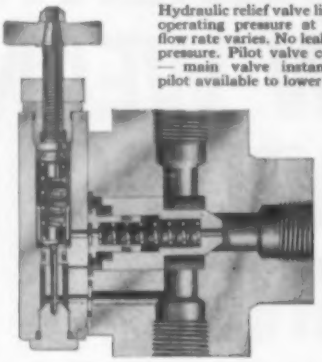
REPUBLIC VALVES
FOR EVERY INDUSTRY

RELIEF VALVES

WITH

- EXCLUSIVE FEATURES
- SMOOTH OPERATION
- LONG LIFE

PILOT-OPERATED RELIEF VALVE

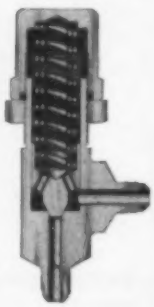


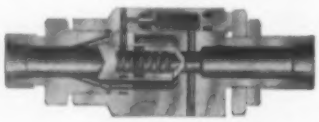
Hydraulic relief valve limits system's maximum operating pressure at constant level, though flow rate varies. No leakage loss below cracking pressure. Pilot valve controls pressure setting — main valve instantly conforms. Remote pilot available to lower setting of integral pilot control. 3 pressure ranges: 50 to 1200 psi; 1000 to 3000 psi; 2500 to 5000 psi. 50,000 tensile semi-steel body standard aluminum alloy to order. FMP or str. thread gasket seal bosses, ¼" to 1¼". Panel mounting bosses.

Modified units available as Sequence Operating Valves; and as Unloading Valves for clamping or other two-pressure applications.

POPPET TYPE RELIEF VALVE

Smoothly sliding poppet, seated by a stainless steel compression spring is the simple design of this rugged unit. External adjustment. Two types of sealing elements available. Soft seal poppets for air, gas, and liquids, with no leakage; stainless steel poppet for general hydraulic applications. Other poppet materials available for special chemical services. Eleven pressure ranges to 2750 psi, ⅛" to ¾" pipe, tubing, internal straight threading. 250°F std — specials to 400°F. Aluminum alloy, brass, or stainless steel.





ADJUSTABLE IN-LINE RELIEF VALVE

External relief adjustment without breaking line is the feature of this 5000 psi relief valve. Limits hydraulic system's maximum pressure at constant level, with minimum rise above cracking pressure. Turning locknut on body varies relief pressure adjustment spring in pilot valve. Free reverse flow. 2 pressure ranges: 50 to 2500 psi; 2000 to 5000 psi. Stainless steel body with hydraulic o-ring, -65° to 160°F standard. Packings for other fluids, and higher temperatures available. Flare or flareless tube connections ⅛" and ¾".

Distributors in principal cities coast to coast

CHECK RELIEF SELECTOR GLOBE NEEDLE PLUG

RM REPUBLIC MANUFACTURING CO.
15655 BROOKPARK ROAD • CLEVELAND 35, OHIO

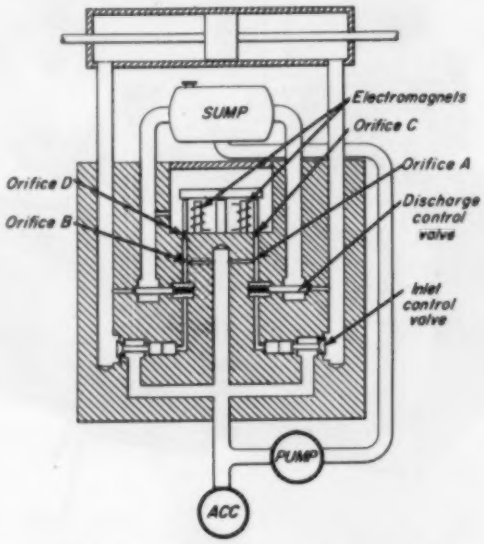
Circle **119** on Time-Saver Card

FLUID POWER PATENTS

Electrohydraulic Servo Valve

Valve design reduces dead band about the neutral position by using separate valves for flows to and from the cylinder. It is also force sensitive. If load force becomes greater than force from fluid pressure, the cylinder reverses. It is made force sensitive by balancing output pressure against pilot or control pressure in a 1:1 ratio.

• **Operation**—With the valve in neutral, pressure fluid enters at the bottom and is shut off from both



cylinder ports by the closed inlet control valves. It flows through orifices *A*, *B*, *C*, & *D* into the pilot control chamber and back to the sump. When the electromagnet on the left is energized, flow through orifice *D* is restricted in direct portion to the current applied. The backpressure created upstream of the orifice opens the left inlet control valve and the cylinder moves right. The right discharge control valve opens because pressure behind its stem is reduced by orifice *C* opening. Flow from the cylinder returns to the sump through the discharge control valve.

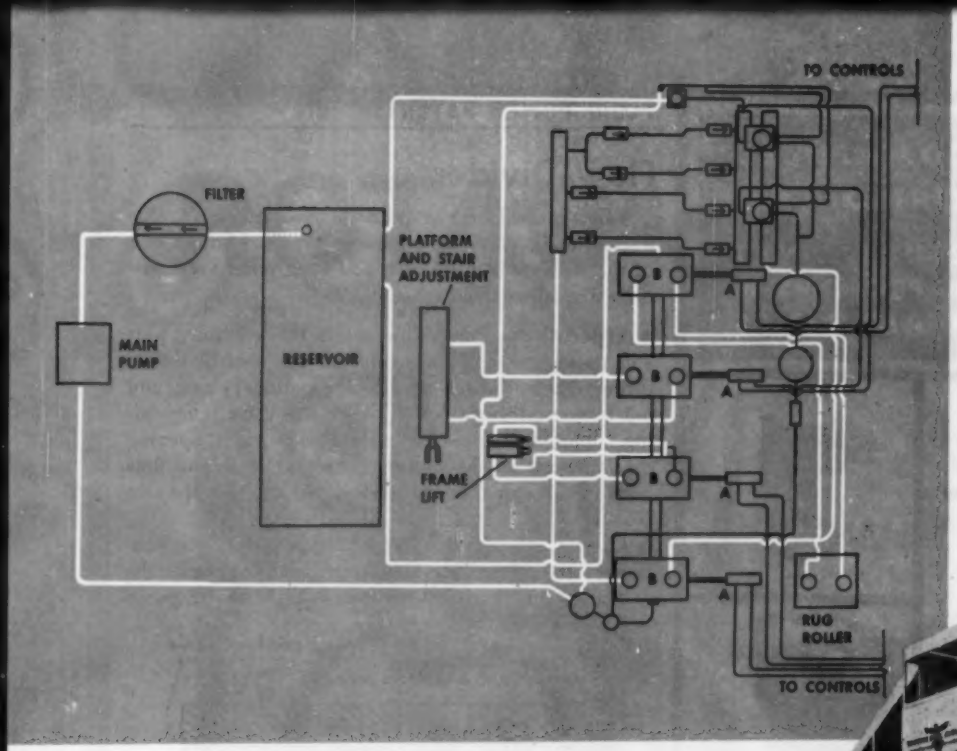
If external force on the piston rod increases until it is greater than the force produced by pump pressure, the piston moves left, opening the left discharge control valve.

When the valve is controlling aircraft control surfaces, this reversing feature prevents wind gusts from over stressing the airframe.

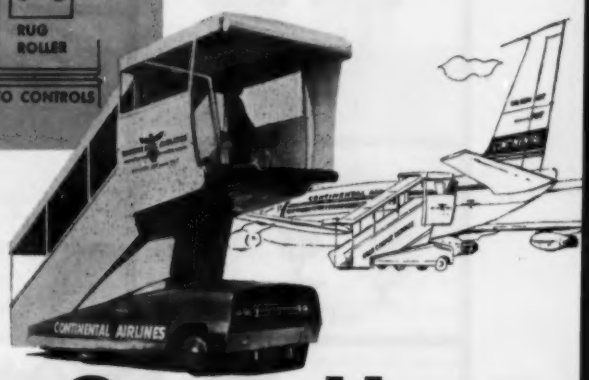
U. S. Patent No. 2,861,550 by Clinton R. Hanna and Lawrence B. Lynn Assigned to Westinghouse Electric Corp., East Pittsburgh, Pa.

Continued on page 144

Circle 60 →



Simplified schematic of hydraulic system shows Gates Hydraulic Hose in white line, other elements in black. Air from 15-psi pneumatic control system enters slave cylinders A, activating high-pressure hydraulic valves B, which in turn operate mechanisms for platform and stair adjustment, frame lift, and rug roller. Hydraulic valves also operate stabilizers (not shown).



Deluxe passenger ramps manufactured by Bil-Jax, Inc., of Archbold, Ohio, for Continental Airlines "Golden Jet" service feature completely self-contained operation: raising and lowering of ramp, rolling out Gold Carpet, and driving truck, all from a single set of controls.

bil-jax inc. selects Gates Hose to speed "Gold Carpet" service!

Chosen by Continental Airlines to develop and produce the special ramps required for the carrier's Boeing 707 loading operation, Bil-Jax in turn selected Gates Hydraulic Hose because of "...the quality and reliability of the product, its availability, and the technical assistance available from Gates representatives."

Immediately avaliable in all major markets. Gates Hydraulic Hose — built to meet or exceed SAE specifications — is available nation-wide in wire-braided and horizontal-braided construction in a complete range of sizes, for medium-pressure or high-pressure use. Ask your nearby Gates Distributor for Gates Hydraulic Hose Assemblies booklet, IH 43.

The Gates Rubber Company • Denver, Colorado
Gates Rubber of Canada Ltd., Brantford, Ontario

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TPA 467

Gates Hydraulic Hose / : Made in a Full Range of Sizes Medium-Pressure, High-Pressure

Rx The RECOMMENDED PRESCRIPTION for CURING MOISTURE...DIRT and LUBRICATION PROBLEMS in COMPRESSED AIR LINES

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LUBRICATORS

TRIO CONTROLS

DRAIN TRAPS

AUTO-PNEUMATIC CONTROLS

OPTIONAL WITH THE NEW Arrow NON-SHATTER PLASTIC BOWLS

Pipe Line Sizes ¼"–⅜"–½"–¾" and 1"

Catalog #30 Sent on Request

REDUCE { REPAIR / DOWN TIME / MAINTENANCE } COSTS

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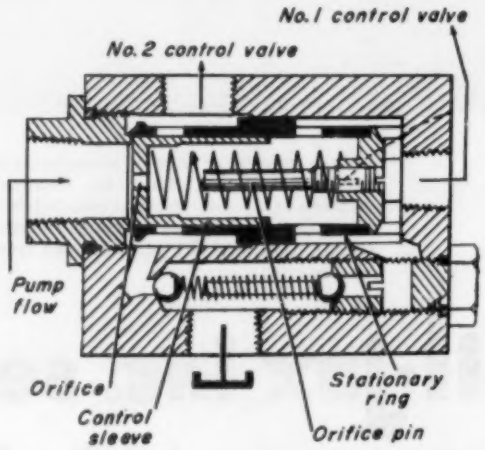
Circle **12** on Time-Saver Card

Flow Divider

Valve is designed to decrease flow in one stream when flow in the other stream increases. Flow in one of the streams is adjustable and both relief valve settings are adjustable.

• **Operation**—Pump flow enters the left valve port and passes through the orifice in the control sleeve, through the peripheral ports in the stationary ring, and out to control valve No. 1. When the valve is operating, pump flow moves the control sleeve right, opening the left ports in the stationary ring. The second flow path is through these ports and out to control valve No. 2.

Flow to control valve No. 1 is regulated by the location of the orifice pin. This pin partially blocks the orifice as the control sleeve moves right under pump



flow. Position of the pin is adjusted by inserting a screwdriver through the port for control valve No. 1. The adjustment is tamper-proof when the valve is piped into the circuit.

If no oil is being used by control valve No. 1, the control sleeve moves against the orifice pin. Full pump output is then available for control valve No. 2.

Each flow path has a ball type relief valve. The balls are held on their seat with a common spring. Relief pressure is set by moving the right hand seat in or out. The valves can be designed to relieve at different pressures by machining larger or smaller seats for the valves.

U. S. Patent No. 2,859,762 by Oscar H. Banker, assigned to New Products Corp., Skokie, Ill.

Other Patents Issued

SERVOVALVE

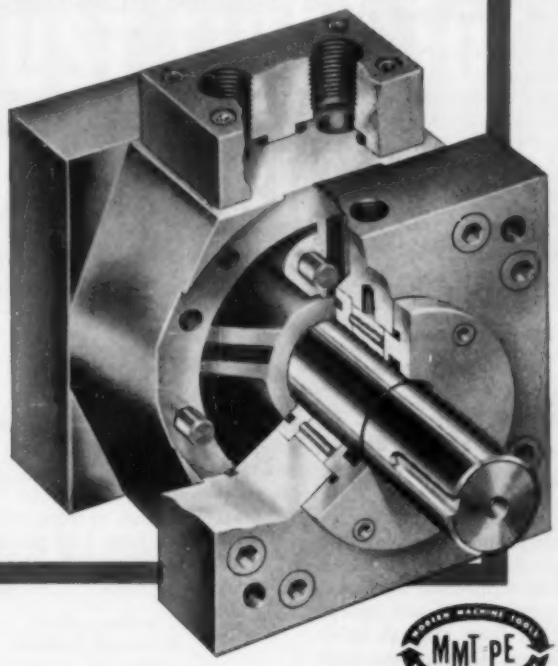
U. S. Patent No. 2,909,195 by Donald E. Keyt, assigned to Borg-Warner Corp., Chicago, Ill.

PILOT-OPERATED 4-WAY VALVE

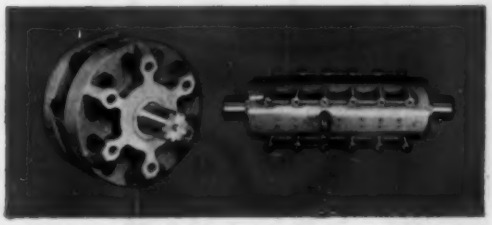
U. S. Patent No. 2,912,007 by Clarence Johnson, South Euclid, Ohio.

ROTAC

RECIPROCATING ROTARY TORQUE ACTUATORS



for precise movement, instant torque in a compact power package!



Large illustration shows construction of Model RN (roller bearing) Rotac. Above is a journal bearing type, Model HN. The special Rotac Reciprocating Torque Actuator at right delivers 1,400,000 in./lbs. torque at 1,000 psi.

Power provided to lift, lower, turn, rotate, index, clamp, toggle, transfer, press, load, unload, turnover or oscillate.

Power available at any angle, in single or manifold installations, with shaft or body rotating in any arc to 280°.

Power packed with torque ratings from 100 to more than 200,000 inch-pounds in standard models.

Power controlled by valves for starting, stopping, slowing-down or speeding-up.

Power source can be air, oil, or fire-resistant fluids. Rotac can also be supplied for use with corrosive fluids.

Power engineered for the heaviest industrial applications or the lightest, most precise uses. Standard units as small as 6″ x 4¾″ (round body) or 6½″ x 4¼″ (square body).

Power designed into 26 cataloged models, with over 300 "standard modifications" to meet your needs in size, torque, load, travel, operating temperature or pressure. (Engineering service available for unusual applications.)

Power protected by patented O-ring seals. Rotac has no complex linkage, no plunger action, no external moving parts.

FREE DESIGN DATA BOOK

20 pages on how Rotac works, torque ratings, dimensions, installation, typical applications and special uses. See your Rotac Representative, or write direct.

SEE EX-CELL-O'S BOOTH 946, NMTBA EXPOSITION

60-55

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Greenville Plant, 945 E. Sater St., Greenville, Ohio

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GIVE US A LISTEN! FOR THE FINEST IN CUSTOM CYLINDERS AND VALVES, CALL, WE'LL TALK!!!!

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DIVISION OF HOLAN CORPORATION
P.O. BOX 4500
CLEVELAND 24, OHIO
PHONE WHITEHALL 2 4595

Circle **142** on Time-Saver Card

NEW PRODUCTS

Continued from page 68

PISTON WEAR RINGS
. . . of glass-filled nylon

Features: For such heavy hydraulic applications as tractors and off-the-road equipment. Excellent wear resistance. Need no lubrication. Low coefficient of friction. Will not gall cylinder walls even on pistons with canted reciprocation. Will imbed tramp metal.

Specifications: Sizes from 2" to 7".

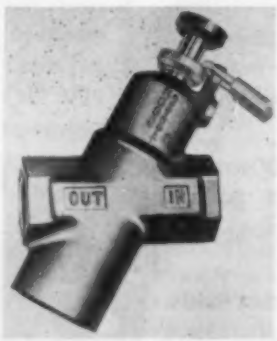
Garlock, Inc.
Palmyra, N. Y.

Circle **305** on Time-Saver Card

LOCK-OUT & EXHAUST VALVE
. . . a safety device

Designation: L-O-X

Features: Increases safety during repair, maintenance, and shutdown of machines which use compressed air. Install in supply line leading to machine, upstream of any operating valve. Air flows through valve. Detented open. One moving part. When valve shifts, air to machine is shut off. Downstream air is exhausted. Can be locked in closed



position. If circuit has closed-center valve, air can be trapped downstream of it. Lock-out and exhaust valves should be installed on each outlet port of closed-center valve. Isolates and inactivates segments of air circuits. Area through valve is greater than interior of standard pipe for which it is tapped.

Specifications: Four sizes for ⅜" to 1" pipe.

Ross Operating Valve Co.
Detroit, Mich.

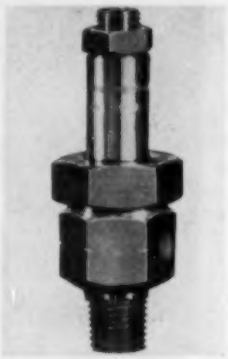
Circle **306** on Time-Saver Card

AIR GOVERNOR
. . . actuates air equipment

Designation: Gov-N-Air

Features: Controls continuous running compressors and vehicle air-brake systems. Can actuate automatic tank drains which expel moisture and sludge from compressor receiver tanks.

Specifications: Adjustable locking screw and set of springs adapt unit



to pressures from 20 to 250 psi. Cut-in, cut-out, or differential pressures range from 4-14 psi upwards. Will endure 3 million uninterrupted cycles.

Wilkerson Corp.
Englewood, Colorado

Circle **307** on Time-Saver Card

3-WAY VALVES
. . . mount to line

Designation: Series A

Features: Solenoid valves have zinc die-cast bodies. Stainless steel internal parts. Soft, synthetic seal inserts are bubbletight. For air, oil, inert gases, and vacuum.

Specifications: In 3/32", ⅛", and 5/32" orifices. Operate on pressure differentials to 250 psi.

Skinner Electric Valve Div.
New Britain, Conn.

Circle **308** on Time-Saver Card

ROTARY ACTUATOR
. . . has 2 vanes

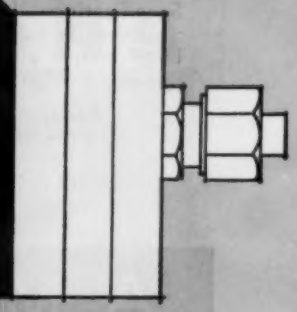
Designation: Model SD102

Features: For rotary shakers, angular positioning devices, and flight simulation tables. Low internal leakage. High stiffness. Low inertia. Low breakout friction.

Continued on page 148

Circle **50** ➔

off-the-shelf pumps just right for your requirements



Whatever you want in a pump — for hydraulics, for flow or process control, there is likely to be an Eastern ready-made unit . . . made-to-order for your needs.

CAN YOU USE THESE PUMP FEATURES:

- ☐ corrosion resistant construction for chemical solutions?
- ☐ ability to handle organic and inorganic fluids at various temperatures with flows up to 70 GPM, pressures to 65 psig?
- ☐ available with open, enclosed or explosion proof motors?
- ☐ compact lightweight units with or without motor?
- ☐ high efficiencies in handling hydraulic oil, fuel and lubricants at high pressures?
- ☐ flow rates from 0.1 to 9.8 GPM, pressures from 0 to 1500 PSI?
- ☐ self-priming operation with non-lubricating liquids?
- ☐ high pressure outputs with small, low power units...and no contamination of fluid?
- ☐ flow rates from ⅓ GPM to 5½ GPM, pressures from 30 to 200 PSI?

An EASTERN CENTRIFUGAL PUMP MIGHT BE JUST RIGHT FOR YOU!

Write for Bulletin 120.

Look into EASTERN HYDRAULIC PUMPS!

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These useful brochures contain full specifications on the complete line in each category, including performance data and tables. They will be sent to you at no obligation whatever. Write Department Y.

EASTERN INDUSTRIES, INC.

100 SKIFF STREET, HAMDEN 14, CONN.

NEW PRODUCTS

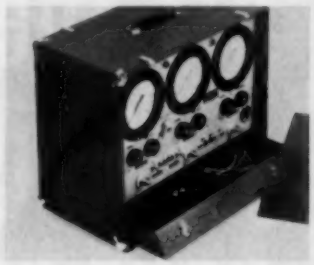
Specifications: Angular travel is ±60 deg, including 15-deg snubbing. Torque at 3000-psi supply pressure is 6750 in-lb.

General Kinetics Div.
Hydra-Electric, Inc.
Burbank, Calif.

Circle **309** on Time-Saver Card

PNEUMATIC CHECK BENCH . . . is portable

Features: Self-contained bench tests pressure switches, vacuum switches, and other pressure or vacuum-operated equipment. Controlled by selector valve which turns on pressure or vacuum supplied by compressor. Circuit jacks available for tests with NO, NC, and common connections. Signal lights indicate continuity of circuits. Needle valves provide fine control of pressure or vacuum. Low, high pressure and vacuum gages have accuracy of .5% of the dial reading. Low-pressure line has regulator. High-pressure line has relief valve.



Carrying case has drawer for small tools, fittings, and other accessories. Removable back and cover.

Specifications: Compressor operates on 28 vdc. Models available for ac. Compressor automatically controlled for 400 psi. Two standard 7/16-20 (¼ tube) pressure ports and one vacuum port. Weighs 56 lb. Measures 21" x 16½" x 11½".

Custom Components
Burbank, Calif.

Circle **310** on Time-Saver Card

AMERICAN
PRECISION BORED & HONED PARTS
TO SPECIFICATIONS

American has produced hundreds of power cylinders to most exacting specifications. Our deep boring and honing techniques have kept pace with the precision internal surfaces needed in the application of air and hydraulic cylinders. Whatever the basic material required, we have the tooling equipment and know-how to produce cylinders up to 16 inches I.D. and to 40 feet lengths.

We are equipped to supply American cylinders bored, honed, flanged, padded and externally machined to your specifications.

AMERICAN HOLLOW BORING CO.

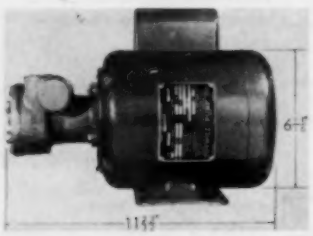
You can depend on American as a reliable source for precision bored and honed parts for your most exacting applications.

1060 West 20th Street • ERIE, PENNA.

Circle **7** on Time-Saver Card

PUMP & MOTOR COMBINATIONS . . . for 20 to 360 gal. per hr.

Designation: Series 56



Specifications: Overall dimensions are 6-11/16" x 11-23/32". Motors in NEMA 56 series from ¼ to 1 hp, single or 3-phase.

Tuthill Pump Co.
Chicago, Illinois

Circle **311** on Time-Saver Card

INJECTION OILER . . . lubricates cylinders

Designation: No. 608

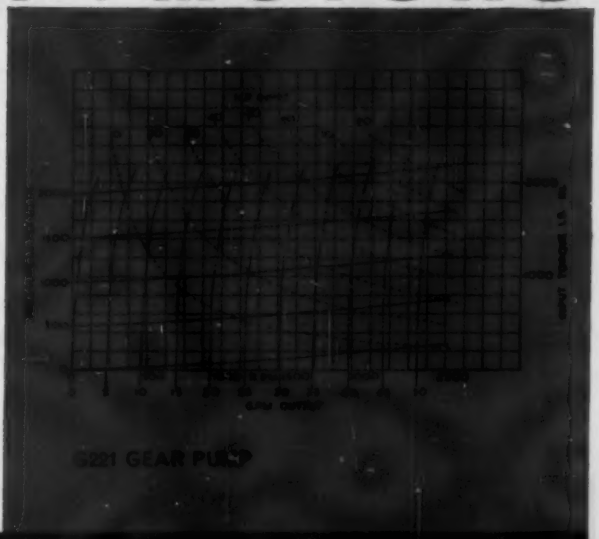
Features: For low-volume, short-stroke cylinders. Provides lubrication previously impossible with ordinary mist-type lubricators. Install between control valve and cylinder. Meters oil direct to

Continued on page 150

KEELAVITE
Hydraulics

GEAR PUMP / MOTORS

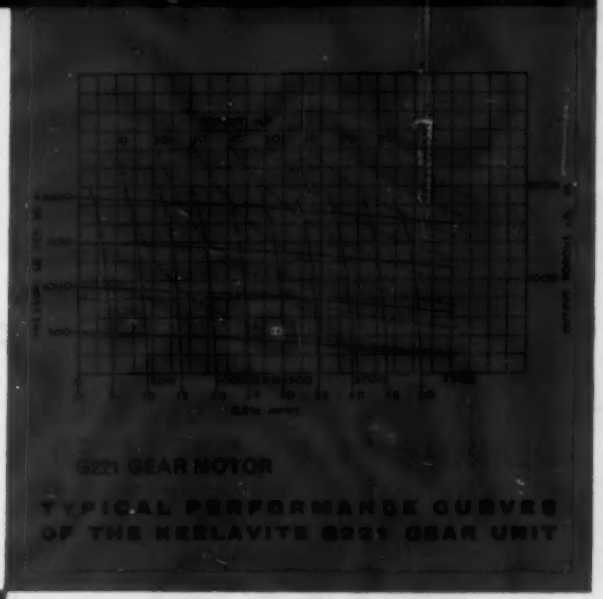
One of the new heavy duty gear pump/motors designed for high continuous rating.



G221 GEAR PUMP

Within the wide range of the KEELAVITE G SERIES of GEAR PUMP/MOTORS, there is a unit suitable for any industrial use. Used as pumps, output ranges from 2.25 gpm. to 180 gpm. Motor torque ranges from 10.5 lb. ins. per 100 psi to 785 lb. ins. per 100 psi.

All of the KEELAVITE PUMP/MOTORS conform to a high standard of workmanship in manufacture, and are reversible without alteration in assembly. The whole range stems from six basic sizes and common components are used within each basic size. All units incorporate roller bearings.



G221 GEAR MOTOR

TYPICAL PERFORMANCE CURVES OF THE KEELAVITE G221 GEAR UNIT

THE RECOGNISED AUTHORITY ON HYDRAULIC POWER TRANSMISSION

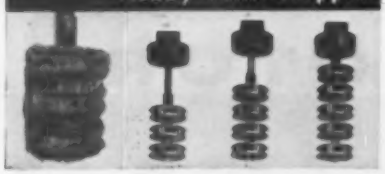
For full details write to—

KEELAVITE
Hydraulics

KEELAVITE HYDRAULICS LTD, ALLESLEY, COVENTRY, ENGLAND
Telephone: Meriden 441

Circle **78** on Time-Saver Card

NEW MAGNETIC CLEANER for HYDRAULIC POWER UNITS the Kebby Tank-Trapper



★ Powerful Alnico V Magnets
★ Highest Active Area
★ Engineered for Power Concentration
★ Easy to Apply
★ Low Priced . . . Quick Delivery
★ No Moving Parts . . . No Maintenance

MEETS NEW J.I.C. HYDRAULIC STANDARDS

The Kebby Tank-Trapper is specifically designed to complete the protection of hydraulic systems against damage by iron particles worn off moving parts of various components. It picks up material missed by the filter and prevents premature filter loading. Expensive shut downs and service calls are drastically reduced. Write for Bulletin 1-500-59.

THE KEBBY COMPANY
2320 Custer Avenue Rockford, Illinois
Designers and Manufacturers of Magnetic Devices, Kebby Mite and Filtray Coolant Cleaners

NEW PRODUCTS

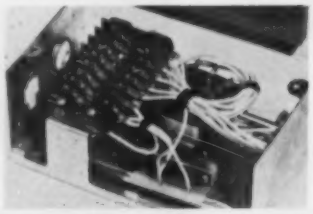
cylinders through capillary tube within cylinder supply line. Oil supplied by standard lubricator placed ahead of control valve, or by small oil reservoir under pressure. Available in kit with necessary fittings and tubing.

Watts Regulator Co.
Industrial Div.
Lawrence, Mass.

Circle **312** on Time-Saver Card

RANDOM REMOTE SELECTOR . . . for ac, dc

Designation: Model RS-550



Features: Use when mechanically-interlocked push-buttons are impractical. Homing-type selector handles 12 stations or selections per unit. Electrically-operated, usually by push-button switches. One switch for each selection. When switch is actuated, selector steps to and homes on proper contact on rotary wafer switch. Makes desired circuit. Stays in position until next actuation. With or without enclosure. Suspension mounting springs insure quiet operation.

Specifications: About 100 steps per second at 115 vac. For variety of ac and dc voltages.

Warco Industries
St. Louis, Mo.

Circle **313** on Time-Saver Card

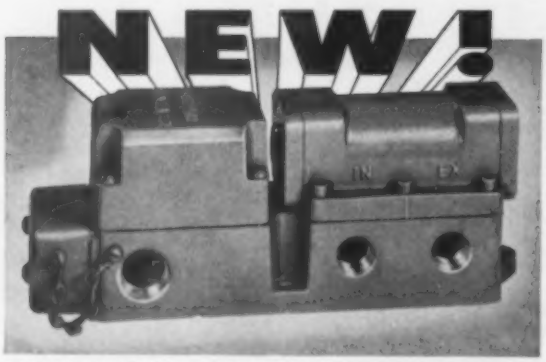
AIR HOSE . . . is coiled

Designation: S12 Synflex Self-Storing

Features: Extends and retracts like telephone extension cord. Nylon hose is impervious to oils. Supplied with reusable couplings. Spring guard prevents crimping.

Specifications: ¾" ID, 25' long hose has total extended working

Continued on page 152



SOLENOID PILOT-OPERATED
4 WAY VALVE

- Separate valve body and solenoid-pilot assemblies for fast, easy servicing.
- Coils (properly applied) guaranteed against burn out for life of valve.
- Low current in-rush (0.26 amps. at 115 volts).
- No springs in main valve.
- Unusually compact design.

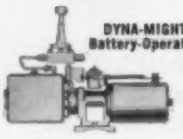
Priced well below average.

AIR VALVES COMPANY
24581 Groesbeck Hwy. • Warren, Mich.

Circle **3** on Time-Saver Card

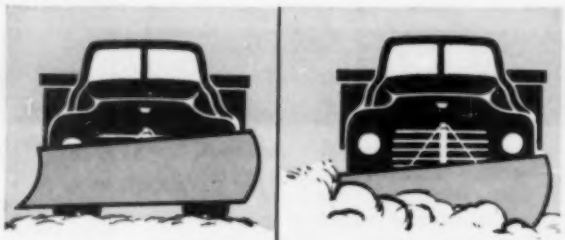
LIFT-LOWER SNOW PLOWS IN SECONDS

MONARCH POWER HYDRAULIC CONTROLS



One man controls the plow from the cab . . . instant up-and-down action with the flick of a wrist. Snow removal is easier, faster, more economical with Monarch. See your dealer or write for illustrated folder.

HY-LO for Jeep Fan-Belt Driven



MONARCH ROAD MACHINERY COMPANY
1331 Michigan St., N.E. — Grand Rapids 3, Michigan

Circle **97** on Time-Saver Card

Melting furnace at Calumet & Hecla, Inc.—Wolverine Division, where Shell Irus Fluid 902 eliminates the danger of hydraulic line fires.

Ready... aim... NO FIRE!

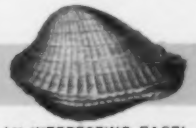
Take 10 high-temperature alloy-melting furnaces, hydraulically operated—each pouring 1500 lbs. of molten metal every hour in close proximity to "live" hydraulic lines—and you can readily see why selection of hydraulic fluids is important to Calumet & Hecla's Wolverine Tube Division.

Now the operation is made more reliable by the use of Shell Irus Fluid 902, a water-in-oil emulsion type fluid. Irus® Fluid was C & H's choice, after carefully studying other commercial hydraulic fluids—for many reasons:

1. Irus Fluid will not support combustion.
2. Irus Fluid has excellent lubricating properties.
3. Irus Fluid has hydraulic efficiency and equipment compatibility.
4. Irus Fluid is economical, costing about one-third less than other fire-resistant fluids.
5. Irus Fluid's bright yellow color makes it easy to spot and trace leaks.

In plant after plant, operators find that these advantages assure maximum safety to both personnel and equipment.

If you have a hydraulic line fire hazard, we suggest that you have the Shell Industrial Products Representative show you the many advantages in Irus Fluid 902; or write to Shell Oil Company, 50 W. 50th St., New York 20, N. Y., or 100 Bush St., San Francisco 6, Calif. In Canada: Shell Oil Company of Canada, Ltd., 505 University Ave., Toronto 2, Ontario.



AN INTERESTING FACT!
Every Shell Branded Industrial Lubricant is named for a sea shell. Shown here is the **Irus** ellipticus.

SHELL IRUS FLUID 902

the low-cost, fire-resistant hydraulic fluid

SHELL

NEW PRODUCTS

length of 45'. Retracts into 5" coil 9" long. Smooth bore and non-flared couplings assure unobstructed air flow, pressures to 200 psi.

Synflex Products Div.
Samuel Moore & Co.
Mantua, Ohio

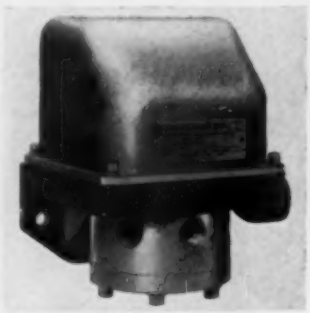
Circle **314** on Time-Saver Card

DIFFERENTIAL PRESSURE TRANSMITTER

. . . for 200-psi differential

Features: Measures pressure difference between two points in fluid system. Transmits information as electrical output. Sensing capsule detects differential pressures. Slug secured to capsule is magnetically coupled to linear differential transformer. Heavy-walled structure contains all hydraulic pressures. Electrical sensing circuit adapts unit to square root extraction for direct readings of flow. Self-contained regulator and demodulator maintain linearity despite variations in excitation voltage.

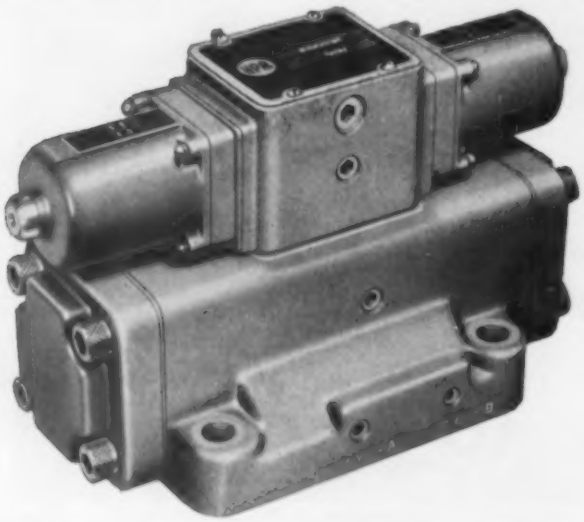
Specifications: Standard model measures differential pressures from



0" to 80" of water. Other units measure differentials to 200 psi. Electrical output from 0 to 1 milliamp dc into 750-ohm load.

Consolidated Controls Corp.
Bethel, Conn.

Circle **315** on Time-Saver Card



NEW H-P-M 1¼" 4-Way Valves Pilot Operated, Solenoid Controlled

The new H-P-M 1¼" 4-Way Valves are designed for continuous service at pressures up to 3000 psi. They feature oil-immersed solenoid pilot valves as standard to lessen shock and wear on both solenoids and valves. They are completely interchangeable with industry standards and are available from stock for immediate delivery.

The new 4-Way Valves offer unusually good flow characteristics. Pressure drop charts, the results of actual tests, are available. Send for your copy, today. Complete dimensional specifications will be included.

Choice of seven spool types; single or double solenoid pilot control; either straight or side outlet subplates available.

HPM

H55

THE HYDRAULIC PRESS MFG. COMPANY
A Division of Koehring Company, Mount Gilead, Ohio, U.S.A.

Circle **74** on Time-Saver Card

GUARD FOR TRANSPARENT BOWLS

. . . now standard item

Designation: Shatter-Guard

Features: Eliminates hazard of bursting transparent air filter and lubricator bowls. Protects bowls from impact. Standard on all Visi-Bowl units and combinations.

Master Pneumatic, Inc.
Detroit, Mich.

Circle **316** on Time-Saver Card

CYLINDERS

. . . have adjustable strokes

Features: Adjusting screw in cylinder's cap end. When turned clockwise, it enters the bore, to act as

Continued on page 154

Circle **133** →

Cleveland Series "J" Wheel-Type Trencher. Spoil conveyor is powered by Sundstrand hydraulic pump.

Sundstrand Hydraulics—the proved way to increase the efficiency of auxiliary drives

Today Sundstrand hydraulic power transmission components and systems are providing greater operating efficiency and ease of control for a wide variety of equipment—road graders, combines and other farm machinery, mining equipment, trenchers, and many others.

On the Cleveland Trencher "J" series machine (above) a Sundstrand pump powers the spoil discharge conveyor—replacing mechanical drive from the digging wheel. Changing to the Sundstrand powered hydraulic system helped boost the efficiency of the trencher *and* win increased customer approval.

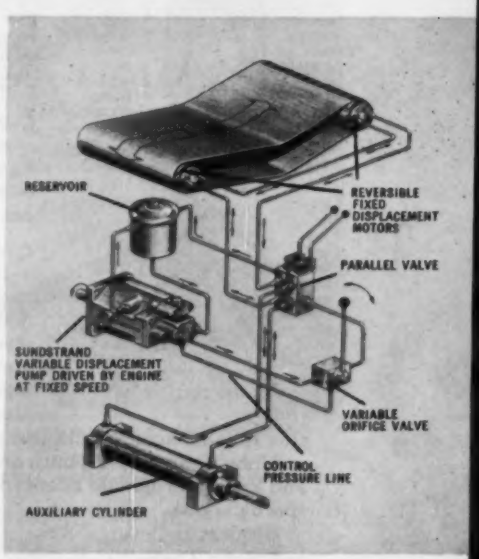
THE SYSTEM consists of a Sundstrand variable displacement pump, a variable orifice valve and two reversible fixed displacement hydraulic motors. The pump delivers *only* the fluid needed to maintain a selected conveyor speed. Power is not wasted pumping oil through bypass circuits when full power (or speed) is not required. As a result, the reservoir can be smaller, more compact and heat build-up is less. System design and assembly are easier for the manufacturer. The user benefits, too, in greater reliability and reduced maintenance.

HOW IT WORKS. The conveyor drive is designed so pump displacement can be controlled from a remote point by a variable orifice valve. A pressure change across the valve is reflected back to the Sundstrand pump through the control pressure line. This signals the pump to change displacement. Varying the orifice size results in a corresponding change in pump displacement.

With the new drive, hard digging no longer means a slow-up in the discharge rate as it did when conveyors were powered by the digging wheel. Now speed of the conveyor is controlled independently . . . set at the most efficient speed to match digging rate of the machine.

CONVEYOR DRIVE REVERSIBLE. Often job requirements dictate on which side of the trench the spoil is to be discharged. With the versatility of hydraulic power, the conveyor can be easily shifted to the proper side and discharge reversed simply by touching a convenient control lever in front of operator.

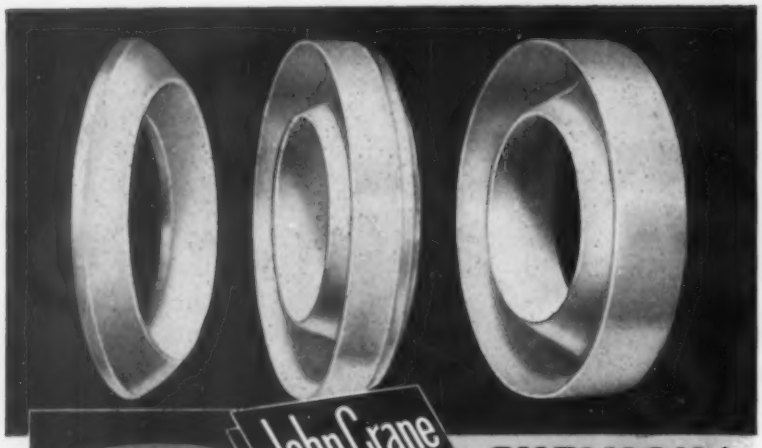
This application illustrates a few of the important operating and sales advantages made possible by Sundstrand drives. A compact, highly efficient Sundstrand hydraulic power transmission system can be the answer to *your* auxiliary power requirements.



If you would like more information about the many application possibilities of Sundstrand hydraulic components and systems, write outlining your requirements to:

Mr. Ray Murphy, *Application Engineer*

SUNDSTRAND HYDRAULICS
DIVISION OF SUNDSTRAND CORPORATION
2210 Harrison Avenue • Rockford, Illinois



John Crane

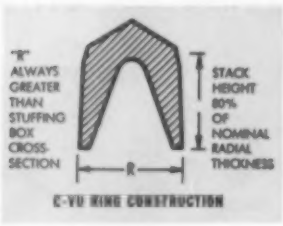
CHEMLON *

C-V RINGS

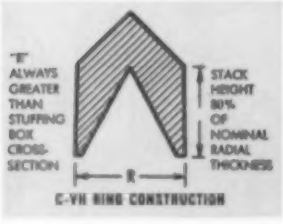
ARE INDUSTRY'S MOST UNIVERSAL PACKING . . .

Countless successful applications of C-V Rings under the most severe service conditions have made this the closest approach to a universal packing.

It will effectively handle all industrial acids, alkalis, solvents, organic and hydraulic fluids . . . temperatures from −120°F. to +500°F. . . . is equally suited to valves, pumps, mixers, hydraulic cylinders and like equipment.



C-VU RING CONSTRUCTION



C-VH RING CONSTRUCTION

"John Crane" C-V Rings have extremely low coefficient of friction. "Breakout" friction is only slightly higher than running friction.

TWO STYLES ARE AVAILABLE:

C-VU RINGS *for low pressure service* —such as control and regulator valves handling gases and fluids, where it is necessary to have a very sensitive and resilient type packing.

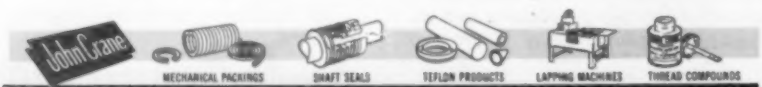
C-VH RINGS *for high pressure service* —for use in pumps, hydraulic cylinders and like services at pressures ranging to 500 psi. and over. These rings are constructed with a heavy wall heel to withstand pressure requirements. They are designed to provide voids between rings, so that as the Teflon expands due to heat, this take-up room minimizes any excess friction in the stuffing box.

"John Crane" C-V Rings are available in full line of standard sizes and male and female adaptors. Sizes can be molded to stuffing box specifications.

Request Bulletin P-325.

*"John Crane" C-V Rings are made from Chemlon—*the best in DuPont Teflon.*

Crane Packing Co., 6405 Oakton St., Morton Grove, Ill. (Chicago Suburb). *In Canada: Crane Packing Co., Ltd., Hamilton, Ont.*



Circle **40** on Time-Saver Card

NEW PRODUCTS

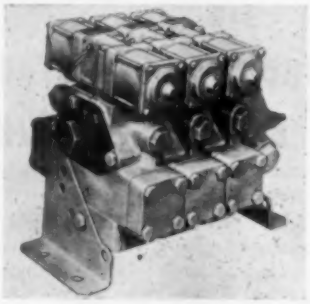
stop to limit stroke. Teflon-sealed straight-thread fitting seals and locks screw. To adjust stroke, loosen fitting, adjust screw, and tighten fitting.

Specifications: Available in all Miller bore sizes.

Miller Fluid Power Div.
Flick-Reedy Corp.
Bensenville, Illinois
Circle **317** on Time-Saver Card

STACKING VALVE . . . for mobile equipment

Features: Solenoid-operated, 4-way, separate segment, stackable valve is rated at 25 gpm. Series or parallel circuits. Stack assemblies with 10 or more operating segments. Built-in relief and pilot pressure control valves are optional. A-c, d-c solenoids or remote control. Spring-centered, spring-offset,



or detented main spool for manual or mechanical control. Pilot pressures internal or external. Adjustable pilot choke control varies spool speed and eliminates shock.

Specifications: 3000 psi, intermittent to 5000 psi. ⅜" straight thread porting for ⅜" OD tubing.

Mobile Div. Racine Hydraulics & Machinery, Inc.
Racine, Wis.
Circle **318** on Time-Saver Card

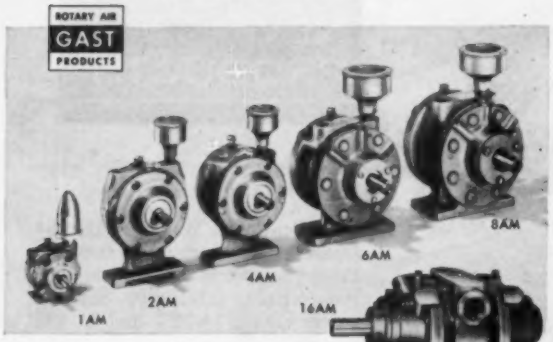
SELECTOR VALVE . . . has 6 positions

Features: Manually-operated multiple-selector valve has spherical rotor that permits selection of flow from one of six sources, or directs flow to one of six circuits. Use in machine tool, test stand and other

Continued on page 156

Circle **59** on Time-Saver Card

ROTARY AIR
GAST
PRODUCTS



Six sizes . . . all variable speed, explosion-proof

GAST rotary vane AIR MOTORS

Need compact, low cost power? For plant use and original equipment applications, Gast rotary-vane Air Motors offer these distinct advantages:

1. Explosion-proof power. No danger!
2. Low initial cost per rated h.p.
3. Variable speed with valve control.
4. Can't burn out from overloads.
5. Vanes take up their own wear.
6. Reversible rotation (opt.) 5 sizes.
7. Very compact — light in weight.
8. Top-quality ball-bearing design.

TYPICAL PERFORMANCE		
Model No.	H.P. at 90 PSI 2000 RPM	Weight lbs.
1AM	0.13	1½
2AM	0.57	5½
4AM	1.1	8
6AM	2.0	17
8AM	4.0	25
16AM	7.0	65

Gast Manufacturing Corp. *Write for Bulletins — specify models!*
P.O. Box 117-D
Benton Harbor, Mich.

GAST ROTARY
"Air may be your answer!"
* AIR MOTORS TO 7 H.P.
* COMPRESSORS TO 30 P.S.I.
* VACUUM PUMPS TO 28 IN.

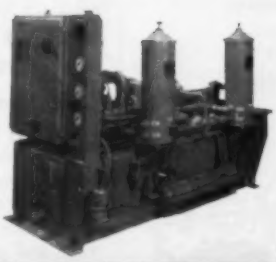
CARDWELL

Trademark
SINCE 1829

CUSTOM ENGINEERING IN INDUSTRIAL HYDRAULICS

Design and fabrication of power units, hydraulic or electrical control panels, and accumulators. Stocking distributors for leading hydraulic components.

Talk over your special needs with the Cardwell Service Engineer in your area.

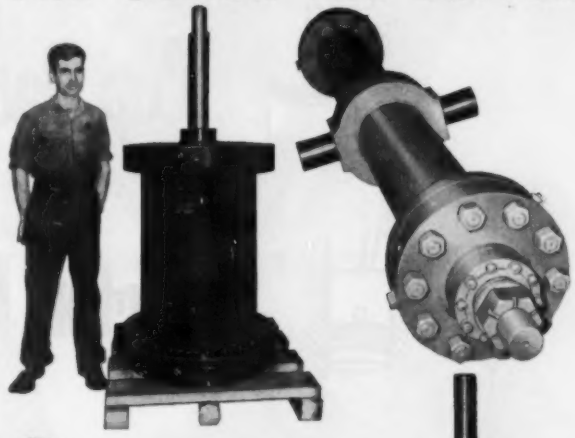


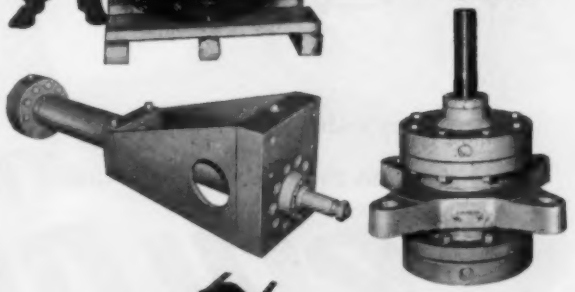
The CARDWELL MACHINE COMPANY
Quality — A CARDWELL TRADITION SINCE 1871
Franklin at 19th St., Richmond 11, Virginia • Phone Milton 4-4593

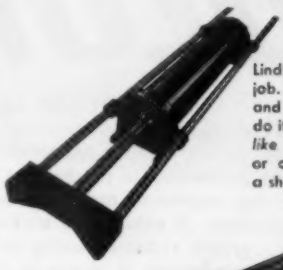
Circle **30** on Time-Saver Card

SPECIAL CYLINDERS

ANY SIZE OR SHAPE . . . THE ODDER THE BETTER







If someone tells you to shove it, Lindberg will build a cylinder to do the job. We've built specials—real odd balls and we have the kind of a shop that can do it at prices you will find interesting. *We like to build specials!* Send us your prints or other description for fast action with a sharp pencil.

NFPA

STANDARDS TOO, OF COURSE!
Air and hydraulic cylinders in a wide range of types, mounting styles and bore sizes with money saving features. Built to JIC recommendations. Standardized mounting dimensions.

REPS—*some territories still open. Write for details.*

FOR MORE INFORMATION ON STANDARDS, WRITE FOR THESE BULLETINS!

BULLETIN S-101-A—SQUAREHEAD "S" LINE
BULLETIN H-101 —2000 PSI "H" LINE
BULLETIN A-101 —HEAVY DUTY "A" LINE

LINDBERG AIR and HYDRAULIC DIV.
TEER-WICKWIRE & CO.
1802 WILDWOOD AVE. • JACKSON, MICHIGAN

Circle **135** on Time-Saver Card

Shaft Seals

Cup Packings

Piston Rings

Much stronger, they last longer when they're of reinforced TFE* RULON®

Because Dixon's self-lubricating RULON has all the advantages of Teflon (low friction, chemical inertness, zero moisture absorption, extreme temperature range) PLUS a tremendous increase in mechanical strength and wear resistance, this engineered material is a natural for sealing applications. It exhibits no stick-slip characteristics . . . greatly reduces starting torques. And unlike rubber or leather, it retains its original dimensions, maintains positive contact with shafts or cylinder walls, and has infinite shelf life . . . being completely unaffected by weather, light, or heat. This material is now available with improved sealing action and at costs competitive with leather and rubber due to Dixon's new post-forming technique!

Want complete data? See our Catalog in Sweet's Product Design File, or ask for Brochure #9572.

DIXON CORPORATION, Bristol, Rhode Island

*DuPont Fluorocarbon Resin

Dixon Suppliers of basic shapes and fabricated parts in Rulon and Teflon

Circle **46** on Time-Saver Card

NEW PRODUCTS

small, high-pressure circuits where low turning torque is required.

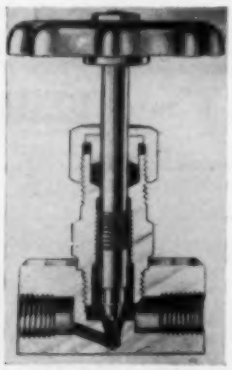
Specifications: Weighs 1¾ lbs. Operating pressure up to 6000 psi. Proof pressure is 10,000 psi. Rated flow capacity is 0.5 gpm. Standard valves have ¼" NPTF and ¼" SAE ports.

Sarasota Precision Products, Inc.
Sarasota, Florida

Circle **319** on Time-Saver Card

NEEDLE VALVES . . . withstand 10,000 psi

Features: For hydraulic service where corrosive liquids are used. Machined from carbon-steel bar stock or 416 stainless steel. Female



pipe threads at both ends are longer than standard to insure tight fit on under-sized pipe. Die-cast alloy handle dissipates heat.

Specifications: Withstand 10,000 psi at 70 F. Special packing for 550 F.

Marshalltown Mfg. Co.
Marshalltown, Iowa

Circle **320** on Time-Saver Card

RATE-OF-FEED INDICATOR . . . has automatic override

Designation: Model RF II

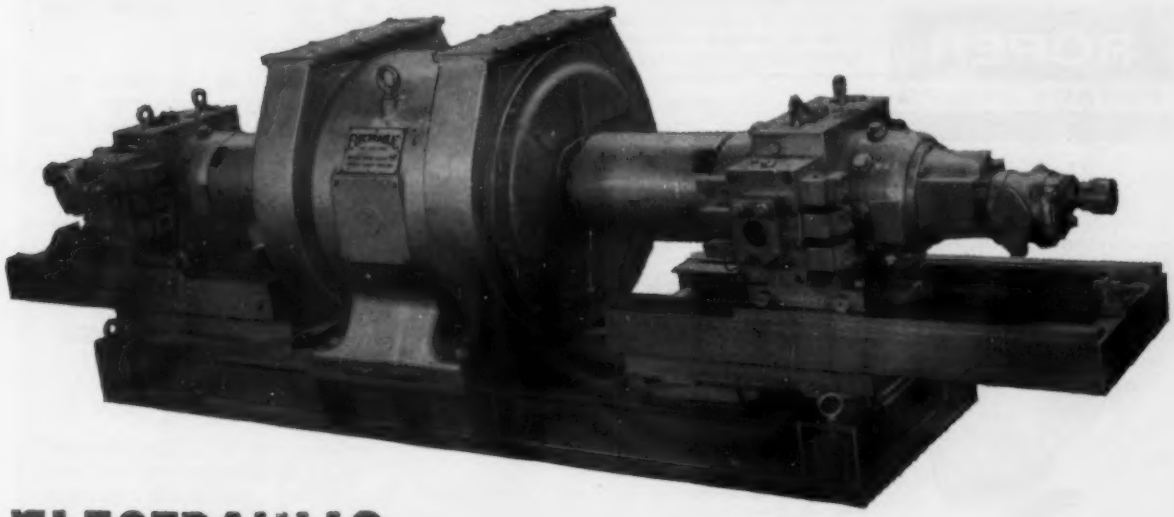
Features: Monitors rate of feed of machine tools which use hydraulic or pneumatic actuators. Use with automatically-controled linear actuators which require close observation, and prediction and adjustment of rate of travel. Tells whether machine is being run at full production capacity. Monitors multiple speeds without field calibration or

Continued on page 158

Something Newer & Bigger from TOWLERS

a 800 h.p.

HYDRAULIC PUMP UNIT



ELECTRAULIC
PUMPS
CONTROLS
AUTODRAULIC

The illustration shows a New Towler Series 500 Axial Plunger oil pump mounted at each end of a motor. Each pump discharges 140 US Gallons per minute at 5000 p.s.i. at 1200 r.p.m. i.e. 400 h.p.

This pump embodies all the successful design features and know-how of the smaller well tried 'A' Series axial plunger pump.

The working parts in the pump body are designed on the cartridge principle to facilitate quick servicing, the plunger bores are filled by an internal gear boost pump which also supplies oil to lubricate the working parts.

FOR FURTHER DETAILS AND DATA SHEETS REGARDING THIS PUMP CONTACT

TOWLER BROS. (PATENTS) LTD.

RODLEY, NR. LEEDS

TELEPHONE: PUDSEY 3125 TELEGRAMS: 'ELECTROLIC' RODLEY

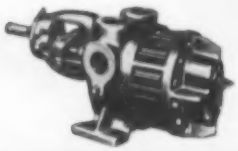
CANADA & USA: Walter Miller, 1770 Jane Street, Weston Toronto, Ontario. Tel. CHerry 1-9128

WHATEVER YOUR REQUIREMENTS FOR ROTARY PUMPS, THERE'S A ROPER TO DO THE JOB

Series T .3 to 55 GPM
Choice of 192 Models

Pump and motor units . . . pump serves as end bell of motor. Require minimum space . . . easily installed . . . no coupling required . . . mount in any position. Each unit approximately same size as NEMA motor of HP required for driving. Open drip proof or totally enclosed motors; single or three phase as required.

ROPER
ROTARY PUMPS



Series F 1 to 300 GPM
Pressures to 300 PSI

Feature helical steel pumping gears, hardened steel shafts, bronze flange-type bearings. 4-port design with 8 optional piping arrangements (4 for CW and 4 for CCW rotation) solves installation problems. With or without built-in relief valve in either mechanical seal or packed box construction.

ROPER
ROTARY PUMPS

Series K ¾ to 50 GPM
Pressures to 150 PSI

Extremely compact in all sizes. Helical pumping gears are hardened steel, with steel shafts and bronze bearings. Sizes 10 through 50 GPM have patented venturi suction and discharge principle for smooth flow and quiet operation. With or without built-in relief valve; packed box or mechanical seal.

ROPER
ROTARY PUMPS

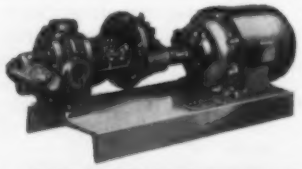
Series H 5 to 75 GPM
Pressures to 1000 PSI

Designed to operate at direct motor speeds. Used for all types of hydraulic mechanisms where high pressures are required. Hardened steel spur gears for maximum efficiency, and heavy duty roller bearings and bronze wear plates for long life service. Mechanical seal or packed box.

ROPER
ROTARY PUMPS

Series 3600 40 to 300 GPM
Pressures to 100 PSI

Handle thick or thin liquids at slow speeds. Operate in either direction. Hardened iron pumping gears, hardened steel shafts, heavy duty bronze sleeve bearings. Mechanical seal or packed box. Series includes tank truck pumps as well as single motor driven units with gear reduction.



ROPER
ROTARY PUMPS

Send for
"How to Solve Pumping Problems"

Roper Hydraulics, Inc. COMMERCE, GEORGIA
Manufacturers of Standard, Special and Custom Pumps for All Industries

Circle **122** on Time-Saver Card

NEW PRODUCTS

adjustments. Automatic reel rewind assures operator of positive tracking with no effort. Rapid travel in either direction, because spring-driven reel tracks rate of feed. Automatic override avoids damage during rapid acceleration. Regulated power supply. Indicator is transistorized and permanently calibrated. Heavy cast aluminum housing resists tough treatment.

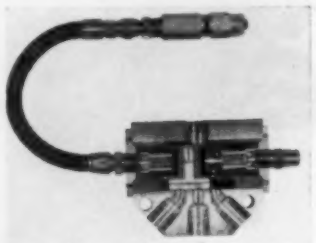
Digitool Corp.
Houston, Texas

Circle **321** on Time-Saver Card

AIR VALVE
. . . does not leak

Designation: Novi-Matic

Features: No air loss through poppets when valve is stationary. Teflon slide valve requires only 6 lbs. force to actuate at 100 psi line



pressure. No lubrication required. No air loss through exhaust ports when slide valve passes over center of stroke. May be used as 3-way valve by blocking one port.

Specifications: 2½" high, 3¾" wide, and 1⅛" thick. Poppet connections, ⅛ NPT; cylinder connections, ¼ NPT.

Novi Tool & Machine Co.
Novi, Michigan

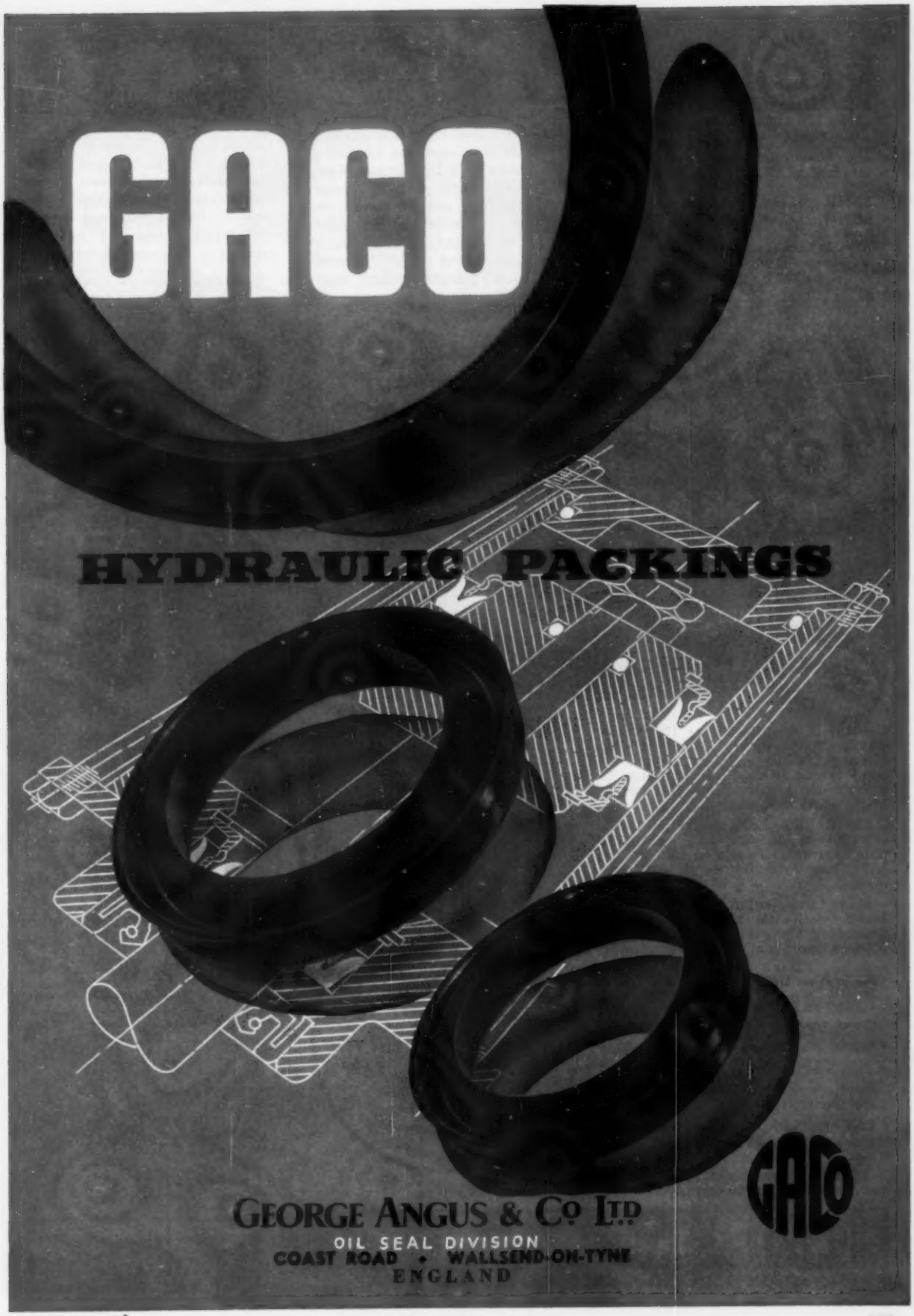
Circle **322** on Time-Saver Card

AIR PRESSURE REGULATOR
. . . has knurled top adjusting knob

Designation: Mini-Reg

Features: Venturi assembly assures high flow rates with virtually no fluctuation of delivery pressure. Operates in any position. Handles left-to-right or right-to-left flow.

Continued on page 160



Circle **10** on Time-Saver Card

NEW PRODUCTS

Available for wall or panel mounting. Diaphragm has Buna N reinforcement.

Specifications: For 80 cfm air flow at 100 psi with 200-psi supply.

Jarett Compressor & Equipment Co.
Newark, N. J.
Circle **323** on Time-Saver Card

PUMP
. . . in 5 sizes

Designation: Model H Series 15

Features: All internal parts machined from one reference—the gear center line. Gear bearings act as dowels. No dowel pins. Available with flange or pad mountings. Can be furnished with ports to accept tapered thread, straight thread, or SAE split flange fittings. Dynamic seal between gear faces and bronze-alloy gear thrust plates prevent high pressure from reaching low-pressure stage. Thrust plates compensate for wear on gear-face contact surfaces.

Specifications: Sizes from 3 to 24 gpm at 1200 rpm. For continuous duty at pressures to 2000 psi, speeds to 2400 rpm. In ½", ¾", 1", 1¼", 1½", 1¾", and 2" gear widths. Four different shaft end covers: round 6-bolt, type A SAE 2-bolt, type B SAE 4-bolt, and type B SAE 2-bolt. Pumps to 4" total gear width can be mounted in tandem.

Commercial Shearing & Stamping Co.
Youngstown, Ohio
Circle **324** on Time-Saver Card

Capital

HYDRAULIC FILTERS

for Hydraulic and Oil Re-circulating Machinery

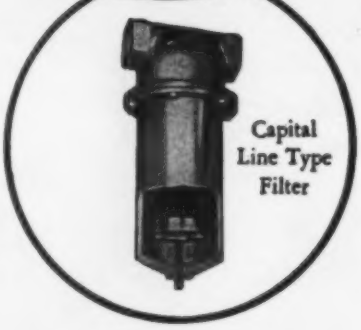
Capital Hydraulic Filter Units are smaller than ordinary filters but with filtering capacity equal or superior to many larger filters. Small size permits greater latitude in design, particularly where space is restricted.

Capital Filter Units are designed with one-piece construction — no screws or nuts to work loose and be lost or mislaid. Simple and easy to clean by any method.

Made from specially designed woven Monel wire, with narrow corrugations presenting the greatest filtering area. Monel support supplies extra sturdiness.

Capital Filter Units are made in 4 Types:

- MONO-BILT 60 Mesh All Stainless Steel (Sump type).
- MONO-BILT Standard All Stainless Steel
- MONO-ECONO Mono-Bilt with Monel Metal Insert and Cadmium Plated Top and Bottom.
- LINE TYPE with Aluminum Housing and Mono-Bilt, one Piece Filter Unit.



Capital Line Type Filter

Built from Monel Metal they are impervious to rust and corrosion.

CAPITAL ENGINEERING & MFG. CORP.

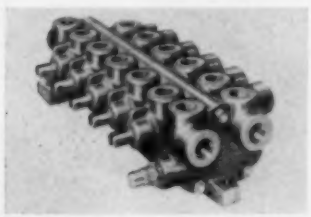
5836 SOUTH ASHLAND AVENUE, CHICAGO 36, ILLINOIS

Circle **28** on Time-Saver Card

DIRECTIONAL CONTROL VALVES
. . . for 2000 psi, 40 gpm

Designation: V20 Series, single valves; MV20 Series, multiple valves.

Features: Heavy-duty valves are for mobile equipment. Differential



pressure relief valves can bypass full line capacities. Ample cross-sectional areas. Minimum of directional changes. Smooth internal surfaces.

Specifications: Capacities are 20, 30, and 40 gpm.

Century Engineering Co., Inc.
Waukesha, Wis.
Circle **325** on Time-Saver Card

PACKLESS VALVE
. . . has soft diaphragm

Features: For unfiltered conditions. Dirt trapped against valve seat does

Continued on page 162

Circle **127** on Time-Saver Card

C10 SERIES HEAVY DUTY
Adjustable, Cushioned
150 psi AIR
1½" to 6" Bore

1 LOW PRICE for any of 4 MOUNTINGS!

C20 SERIES HEAVY DUTY
Non-Cushioned

150 psi AIR
250 psi Hydraulic
1½" to 6" Bore

DELIVERY TO MEET YOUR DEMANDS!

NEW N.F.P.A. Recommended Universal Dimensioning

THE SHEFFER® CORPORATION

Write for NEW Bulletins Nos. 760 and 860

SOLD BY LEADING DISTRIBUTORS NATIONALLY

Cincinnati 15, Ohio
Phone POplar 1-8227

SEE PHONE BOOK YELLOW PAGES

PUSHOMATIC®

interchangeable

QUICK DISCONNECTS

AIR GASES LIQUIDS

connect or disconnect the fastest and easiest way

Just plug in . . . the patented PUSHOMATIC locking mechanism automatically forms a positive leak-proof connection . . . no turning or twisting necessary. Connect to most sockets and plugs regardless of make . . . because the **Series D is interchangeable** . . . interchangeability saves valuable set-up time and reduces costly inventories.

Integral shut-off valve provides fast connection on production set-ups . . . one hand operation permits fast, easy connecting or disconnecting.

360° swivel action reduces operator fatigue and eliminates aggravating hose kinking and twisting.

The **Series D interchangeable** coupling can be used on air, gases, or liquid lines which makes it ideal for most industrial uses. Maximum flow with minimum pressure drop.

The performance and construction of the Series D Coupling meets Military Specifications MIL-C-4109-A.

Write for Bulletin 1500—compare high flow characteristics.

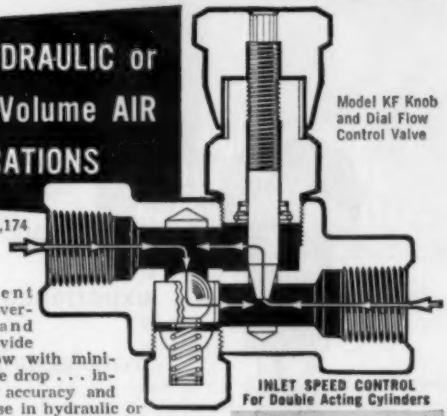
PERFECTING SERVICE CO.
332 Atando Ave. Charlotte, North Carolina
Baltimore - Buffalo - Chicago - Cleveland - Camden - Los Angeles
New York - Providence - Montreal - Toronto - Canada

Circle **108** on Time-Saver Card

AUTO-PONENT® VALVES

FLOW CONTROL, NEEDLE, CHECK

For HYDRAULIC or Large Volume AIR APPLICATIONS

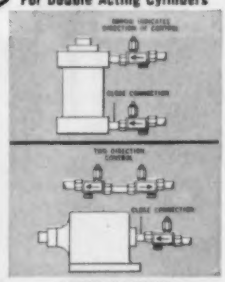


Model KF Knob and Dial Flow Control Valve

Patent #2,841,174

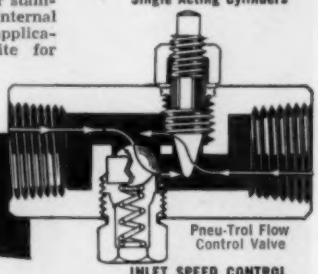
INLET SPEED CONTROL
For Double Acting Cylinders

Auto-Ponent Valves with oversize ports and passages provide maximum flow with minimum pressure drop . . . insure greater accuracy and quick response in hydraulic or large volume air cylinder control. Self-aligning needle has unique Quad-Ring gland seal located at pressure port to seal off threads in needle housing, allowing needle to turn easily under maximum pressures. Gland structure and location also prevents air or dirt trapping in the housing. Flow Control and Check Valves have sensitive, chatterless ball check. Patented design insures rapid ball movement to open or close fully at low differentials. Made in 5 female Dryseal pipe sizes from ⅛" to ¾" inclusive. 3 Models: Standard, Knob and Dial, and Panel Mounting. Valve bodies are forged aluminum (3000 psi), steel or stainless steel (5000 psi). All internal parts are Stainless. Typical applications shown at right. Write for catalog AP59.



SPEED CONTROL
Single Acting Cylinders

For AIR APPLICATIONS

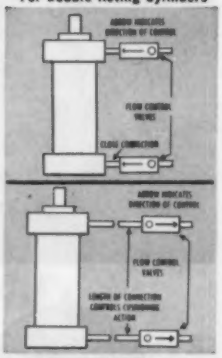


Pneu-Trol Flow Control Valve

Patent #2,811,174

INLET SPEED CONTROL
For Double Acting Cylinders

Pneu-Trol Flow Control, Needle, and Check Valves are widely used for air or small volume hydraulic cylinder control. Extremely compact design permits consolidated piping arrangements. Long tapered needle provides very sensitive and accurate air or oil flow control. Sensitive floating ball check opens or closes fully at slightest differentials. Valve bodies are machined from solid hexagon bars of aluminum or brass (2000 psi) steel and stainless steel (5000 psi). All internal parts are stainless steel. Made in 5 female Dryseal female pipe sizes: ⅛" to ¾" inclusive. Typical applications of Pneu-Trol Flow Control Valves are shown at right. Write for Pneu-Trol Valve Catalog No. 22.



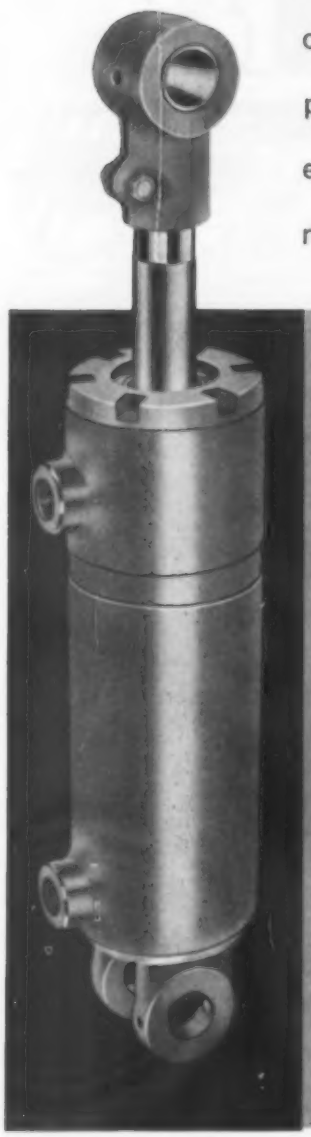
EXHAUST SPEED CONTROL
For Double Acting Air Cylinder

AUTO-PONENTS INC.
2919 Grant St. • Bellwood, Illinois

Circle **14** on Time-Saver Card

Experience

of BHEW in a wide variety of applications is your assurance of dependable product performance. BHEW's engineering experience in precision manufacturing insures lasting service.



BHEW'S 1500 PSI SERIES DOUBLE-ACTING GENERAL PURPOSE CYLINDERS

are designed around component parts but custom-built to your specifications. Available in a variety of mountings with or without adjustable and non-adjustable rod ends.

DISCUSS YOUR DESIGN AND APPLICATION PROBLEMS WITH US!

WRITE TODAY for free Hydraulic Cylinder Engineering Reference data. 78 dimensional basic designs for general purpose and special double- and single-acting cylinders. SAVE TIME!

BH EW

INTEGRITY • CHARACTER • QUALITY

BENTON HARBOR ENGINEERING WORKS, INC.

622 Langley Avenue • St. Joseph, Michigan

Circle **24** on Time-Saver Card

NEW PRODUCTS

not affect soft diaphram. Tight shutoff even during prolonged closed intervals. When valve opens, particles are washed away, and diaphragm resumes original configuration. Knurled-knob actuators available. Bonnets available for panel mounting.

Specifications: Rated for 500 psi. Closes with 10 in-lb torque at that pressure in dead-end service. In brass with ⅛" or ¼" NPT connections.

George W. Dahl Co., Inc.
Bristol, R. I.

Circle **326** on Time-Saver Card

TUBE CUTTERS . . . no external burr

Designation: Kloskut

Features: For steel, copper, brass, and aluminum tubing. Turn knurled knob handle to lower cutting wheel. To cut tube, rotate handle around

tube, and feed wheel with knob. Cutter has retractable blade to burr tubing's inside edge. Replacement cutter wheels and shafts available. Cuts off flared ends of tubing close to flare.

Specifications: Model 216S is for ⅛" to 1" OD. Model 1232 is for ¾" to 2" OD.

Parker Fittings & Hose Div.
Parker-Hannifin Corp.
Cleveland, Ohio

Circle **327** on Time-Saver Card

USE A TIME SAVER CARD FOR MORE INFORMATION ON

- *Advertised Products*
- *New Components*
- *Useful Literature*

Circle **91** on Time-Saver Card

MARSHALLTOWN

Gauges

The right gauge for your specific needs

A complete line of gauges in stock available for early delivery. Gauges from 10-inches water pressure to 30,000 P.S.I. to meet your specifications on any equipment.

- Pressure
- Vacuum
- Compound
- Altitude
- Combination
- Diaphragm
- Hydraulic
- Special Purpose
- Dial Thermometer (Vapor Tension or Bi-Metal)

Let Marshalltown answer your gauge problems . . . write for information and prices.

MARSHALLTOWN MFG. CO.
MARSHALLTOWN, IOWA

USEFUL LITERATURE

Continued from page 64

PISTON ROD SEAL

Seal has rubber D-ring, nested inner wedge nylon ring, and nested outer wedge nylon ring with integral rod wiper. For hydraulic and pneumatic cylinders it operates in any fluid within a range of 70 F to 600 F. Available in standard sizes for rods ½" to 3". *Green Tweed & Co., North Wales, Pa.*

Circle **419** on Time-Saver Card

PROTECTIVE SLEEVES

Accordian, telescopic sleeves protect piston rods, hydraulic rams, and other moving and sliding assemblies. Round, square, rectangular, and triangular sleeves operate in angular, horizontal, or vertical positions. Neoprene material is impervious to oil, grease, and water. Withstands temperature changes

Continued on page 164

palley/s SAVE UP TO 85%

SPECIAL VALUE
LARGE VOLUME STRATOPOWER PUMP

A high volume, positive displacement type hydraulic pump. Has an output to 10 gallons per minute at 1500 RPM with 3000 PSI. Maximum RPM is 4000. Has 16 tooth spline shaft. Part No. AND-20002. 99.50

NEW PALLEY Hydraulic Cylinders

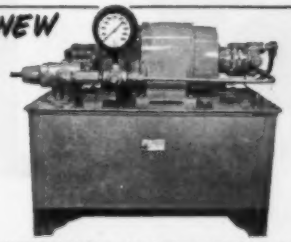
These special Palley Hydraulic cylinders are designed to meet the most rigid requirements of industry. All are of heavy duty steel. Shown here are two of our line. Available in heavy duty Press type cylinders of 3", 5", 6" and 8" bores, with thrusts up to 75 TONS. Also in internal cap types (as at right, above)—with bores up to 4" and up to 18,850 lbs. of thrust at 1500 PSI. Write for complete list of Special Palco Hydraulic Cylinders.

SURPLUS 1500 PSI HYDRAULIC CYLINDER
Has bore of 3" – shaft 1-3/16" – stroke 24" – O/A length 31". Reconditioned. 34.50
palley/s Cat. No. H-36RSU

2263 E. VERNON AVE., DEPT. AH-90
LOS ANGELES 58, CALIF.

TO ORDER: Send Check or M.O. – 1/2 deposit with C.O.D.s. Prices F.O.B. Los Angeles. All items shipped freight or postage collect.

NEW



HYDRAULIC "AUTOMATION" "HI-LO" PRESSURE
PUMPING UNITS
DELIVERS 21 GPM AT 1500 PSI

For use in applications where a fast approach to work load is desired. Will deliver combined volume of both pumps (21 GPM), at pressures up to 450 PSI, then delivers output of high pressure pump (4 GPM) at up to 2000 PSI. Both pumps are face mounted on a 5HP, double end, 220/440, 3-phase, 60 cycle AC motor. Mounted on a 33 gal. reservoir (available without reservoir) Size: 35" long x 18½" wide x 18½" high. Other Hi-Lo units available, write for details. Cat. No. DPR-21-1500.. Only 625.00

2250 PSI CORNELIUS COMPRESSOR AND 115 V. MOTOR
99.50
OUTPUT 0.6 CFM

SAVE!

Consists of a Surplus Cornelius Compressor – combined with a New 1/2 HP, 115/230 V., 60 cycle AC motor; a mounting frame and built-in carrying handle. Pressure tested up to 3000 PSI. Ideal to fill air tanks, laboratory use, etc.

Circle **105** on Time-Saver Card

NEW Fluid Regulators Product

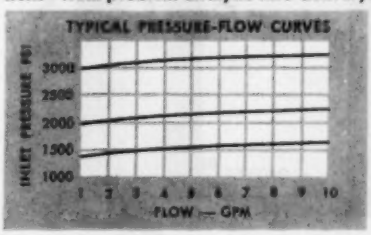
High Pressure
RELIEF VALVE
No Chatter...Only 11 ozs.

- Good Repeatability
- Accurate Pressure Control
- Extremely Stable
- No Hysteresis

• Used in the directional control system of a missile, this small light weight valve was designed, manufactured, tested and delivered in just four weeks.

It can be custom built in a wide range of sizes and design variations to meet users specific size, weight and performance requirements.

Its another example of Fluid Regulator's ability to meet customers exacting specifications—from problem analysis thru delivery.



SPECIFICATIONS

- Performance: exceeds MIL-V-5523B
- Outline And Mounting: meet AN 6279-6
- Mounts: on either side
- Operating Pressure (adjustable): 100 to 4,000 psi in three ranges
- Temperature Ranges: —65° to +275° F.
- Weight: 11 oz.
- Ports: AND 10050-6
- Materials: Aluminum And Stainless Steel
- Part No.: 7485

Write for detailed literature

Fluid Regulators CORPORATION

313 Gillette Street • Painesville, Ohio
ELmwood 2-3319

Circle **55** on Time-Saver Card

USEFUL LITERATURE

from −45 to 220 F, without cracking. Can be compressed to fit tight places. Sizes from ⅝" ID x 2" OD to 8½" ID x 11¼" OD. Specials have been made with diameters to 24", lengths to 30'. Bulletin AH-3. *A & A Mfg. Co., Inc., Milwaukee, Wis.*

Circle **420** on Time-Saver Card

PLUNGER PUMPS

Triplex pumps are for heavy jobs, where severe hydraulic shocks are frequent. For pressure to 20,000 psi, displacement to 58 gpm. Two basic sizes. Several modifications. Vertical design. Automotive-type crankcase. Spring-loaded ball valves have replaceable seats. Built-in lubricating oil pump for pressure and splash lubrication. Scavenging pump returns plunger leakage to system. Chrome-plated steel plungers are lap-fitted to liners. Plungers and liners are interchangeable as assemblies. Pump has stub shaft for separate drive, or has integral induction motor: 220/440 volt, 3-phase, 1800 rpm, dripproof. Integral double-reduction gears available. Built-in relief valve and pressure gage. *Kobe, Inc., Huntington Park, Calif.*

Circle **421** on Time-Saver Card

CUP PACKING

Properties, characteristics, and standard sizes of new Rex-Syn packings are listed. Cups work well in air, oil, and water-base fire-resistant hydraulic fluids at temperature ranges from 0 F to 212 F. Rated at over 3000 psi. *E. F. Houghton & Co., Philadelphia, Pa.*

Circle **422** on Time-Saver Card

REPLACEMENT AIR FILTER

New ULOK Cube type replacement air filter can reduce bank face area by more than one half. Exploded view illustrates how four components are assembled prior to installation in filter bank. Diagram shows typical arrangements. Data table lists capacity and resistance of twelve filter sizes. Bulletin B, *Union Carbide Development Co., New York, N. Y.*

Circle **423** on Time-Saver Card

AIR PUMPS

Rotary vacuum and pressure pumps, including oil-less models. Sizes and accessories are described in Bulletin No. 1360 *Leiman Bros., Newark, New Jersey.*

Circle **424** on Time-Saver Card

ELECTRICAL MOTORS

"The Plus Value That Back Up U. S. Motors" is the title of a full color brochure. It shows production facilities, sales & service offices, warehousing & truck fleets, and emergency service. Also described are the company's communication facilities and use of electronic computers. Bulletin No. F 1974—*U. S. Electrical Motors Inc., Los Angeles 54, Calif.*

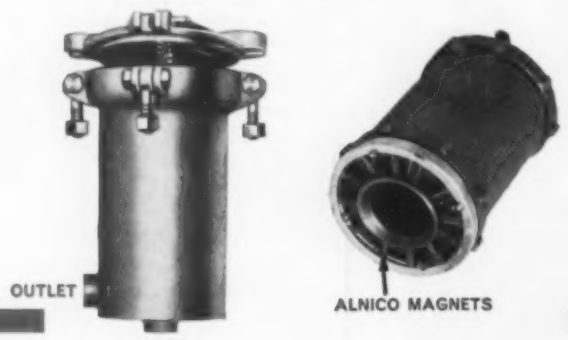
Circle **425** on Time-Saver Card

RAILROAD AIR HOSE AND FITTINGS

Locomotive and railroad hose and reusable fittings are described in Catalog No. 4486. The hose is seamless, synthetic rubber type,

Continued on page 166

GET THE *ADDED PROTECTION* OF MAGNETIC SEPARATION WITH THIS BASKET-TYPE STRAINER



Nugent now manufactures a line of basket-type strainers offering the added protection of magnetic separation. Specially designed Alnico magnets establish a magnetic field through which the strained liquid must pass as a final stage before leaving the unit. Thus, minute ferrous particles are trapped and removed from the fluid stream.

If you have valuable engines or other equipment which demands top-notch lubrication protection, it will pay you to get the full story on the Nugent combination strainer-magnetic separator.

Write today . . . no obligation, of course.

ESTABLISHED 1897

WM. W. NUGENT & CO., INC.

3432 CLEVELAND STREET, SKOKIE, ILLINOIS

REPRESENTATIVES IN PRINCIPAL CITIES

OIL FILTERS • STRAINERS • TELESCOPIC OILERS
OILING AND FILTERING SYSTEMS • OILING DEVICES
SIGHT FEED VALVES • FLOW INDICATORS

Circle **100** on Time-Saver Card

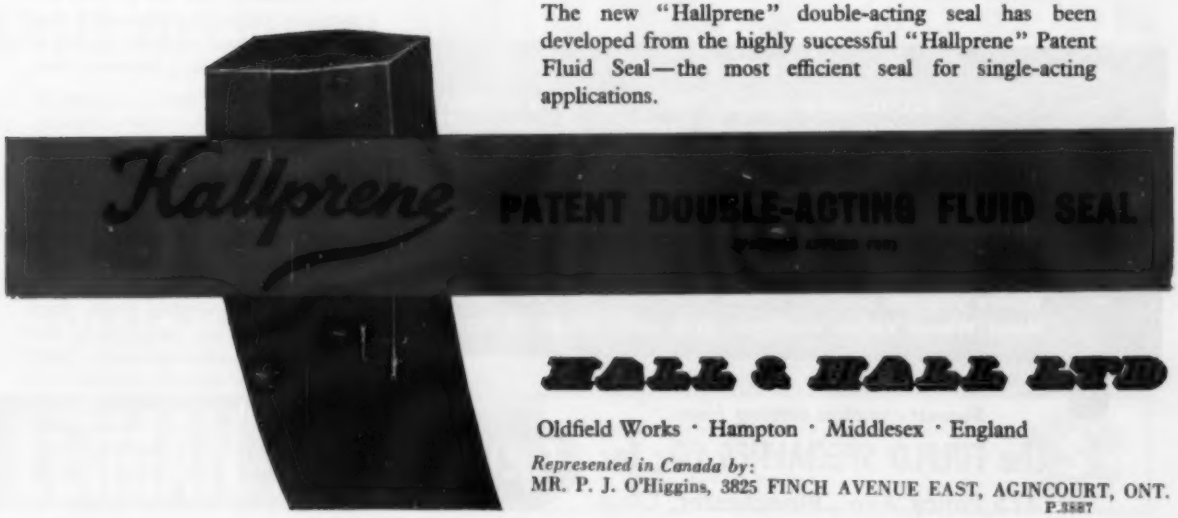
at last...

an *effective one-piece* double-acting seal!

Specially designed for double-acting cylinders—the new "Hallprene" Patent Double-Acting Fluid Seal.

- ✳ Improves sealing
- ✳ Prevents the possible formation of fluid traps
- ✳ Reduces costs
- ✳ Simplifies piston design
- ✳ One seal replaces two

The new "Hallprene" double-acting seal has been developed from the highly successful "Hallprene" Patent Fluid Seal—the most efficient seal for single-acting applications.



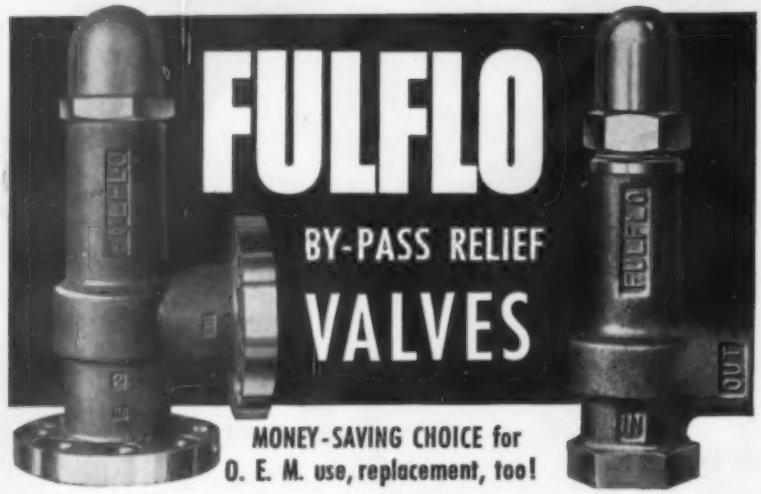
HALL & HALL LTD

Oldfield Works · Hampton · Middlesex · England

Represented in Canada by:
MR. P. J. O'Higgins, 3825 FINCH AVENUE EAST, AGINCOURT, ONT.

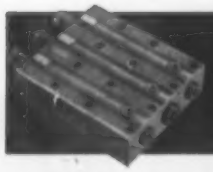
P.3587

for DEPENDABLE HYDRAULIC PRESSURE CONTROL



Low price and high quality make FULFLO piston-type hydraulic valves a natural O.E.M. choice. The service they deliver . . . quiet, dependable and trouble-free . . . makes them ideal from the equipment users' viewpoint.

- **Screw or flange models . . . to 500 lbs. . . . for pipe sizes to 3"**
- **Steel, cast iron or brass bodies . . . brass, steel or stainless trim**
- **Fast shipment of standards . . . specials to your requirements**



NEED A "Special"?
FULFLO can engineer a special valve to your most exacting requirements. Examples of "specials" are shown in Data Book.

FOR EXTRA CONTROL CONVENIENCE
Where frequent pressure setting is needed, install a FULFLO Hand Wheel Valve; available in a wide range of types.

Request complete catalog from:

The FULFLO SPECIALTIES CO., Inc.
415 Fancy Ave., Blanchester, Ohio

Circle **56** on Time-Saver Card

USEFUL LITERATURE

steel-wire-braid reinforced for high tensile strength and flexibility. Outer protective rubber finish is resistant to oil, weather and abrasion. Dimensional tables for hose and fittings. *Parker Fittings & Hose Division, Parker-Hannifin Corp., Cleveland, Ohio.*

Circle **426** on Time-Saver Card

FILTER MEDIA

Filtration Products is a new booklet that lists and details data on various filter media for hydraulic fluids and other applications. Information covers flow rates, filtration degree, fluid viscosity. Reliability of filtration media such as micronic paper, metal edge, wire cloth, porous metal media are described. Oil absorption, and water separation filters, filters for high-low temperatures (−420F to 1200 F) high pressure are also discussed. Bulletin IND-1-60 *Purolator Products, Inc. Rahway, New Jersey.*

Circle **427** on Time-Saver Card

UNLOADING VALVE

Engineering and design information, schematic drawing, typical circuit applications, flow characteristics and dimensions given in new data sheets. Valve automatically diverts pump flow to reservoir after reaching predetermined system pressure. Has 5% to 25% adjustable pressure differential between load and unload positions. *Fluid Controls, Inc., Mentor, Ohio.*

Circle **428** on Time-Saver Card

PACKINGS CHART

Chart suggests seven packing types for 95% of all packing needs. Shows proper packing for pumps and valves, high-temperature valve stems and expansion joints, high speed rotary air compressors and corrosive and viscous liquids. Gives packing for chemicals, gaskets, and hydraulic and pneumatic equipment. R/M Big 7 Chart, *Raybestos-Manhattan, Packing Division, Passaic, New Jersey.*

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Circle **32** on Time-Saver Card

Standard *For* Industry

CENTURY Liquid Level SIGHT GAGES

- **Easiest Possible Installation on any wall thickness**
- **Large Face for Better Visibility— 7" Overall**
- **Can be used with non-inflammable oil**
- **Leak-Proof — No Dripping**
- **For Better Service at Lower Costs, Start Using Century Gages Today**
- **Available Immediately — from STOCK**

Send for new catalog containing dimensional information on hydraulic reservoirs and complete line of power unit accessories.

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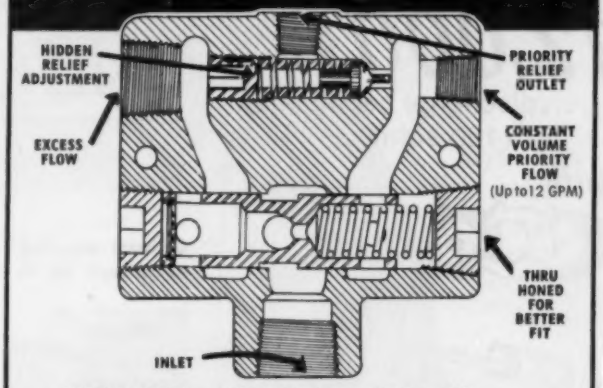
Need a better

Power Steering Divider?



- **LARGER SPOOL** = MORE FORCE SHIFTING SPOOL
- **MORE SPOOL FORCE** = STRONGER SPOOL SPRING
- **STRONGER SPOOL SPRING** = MORE POSITIVE POSITIONING
- **MORE POSITIVE POSITION** = MORE "DEPENDABLE" DIVIDER
- **CROSS-HOLE METERING** = SMOOTHER METERING
- **CROSS-HOLE METERING** = NO DIRT TRAPS

OTHER PRODUCTS . . . Flow Dividers, Adjustable compensating dividers, Adjustable compensating flow control valves, Flow integrators, Pilot operated relief valves, Pilot operated check valves (spool type), Pilot operated unloading valves, Flow equalizers, Hand pumps.

FOR FURTHER INFORMATION WRITE:

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For your Vacuum and Pressure Applications . . .

Get these Exclusive Advantages of LEIMAN HINGED VANE DESIGN!

The time-tested design and quality construction of Leiman Air Pumps improve your machine operation—provide your customers with "Lifetime" durability and freedom from troubles and repairs. Proved by more than half a million installations. If your equipment now uses air pumps—if your new designs require air pumps, contact us for engineering assistance and data on Leiman Air Pumps.

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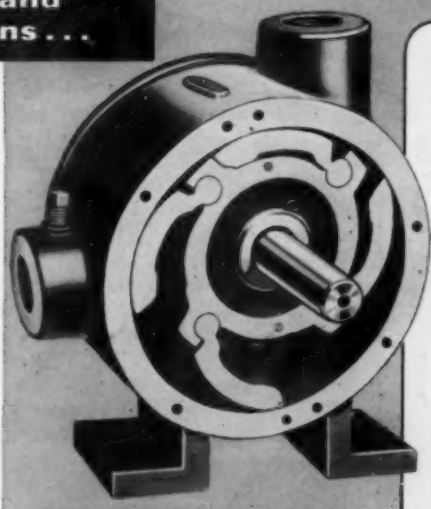
Established 1887



Wide range of types and sizes in
VACUUM to 29.9" Hg.
PRESSURE to 20 Psig.
VOLUME to 162 c.f.m.

- **Four Curved Vanes** scoop up large volumes of air. Easy-action hinges enable vanes to open and close by centrifugal force.
- **Cast Iron Vanes and Cylinders** are precision-machined, then hone themselves to hard, glassy smoothness during operation—take up their own negligible wear—assure leakproof seal and fully-rated capacity for years and years.
- **Extra-large Air Space** provides 2 to 3 times more capacity per pump, permits use of smaller pump.
- **Minimum Maintenance** because simplified design has fewer moving parts—no gaskets or packing—no composition vanes to replace.
- **Also** quiet operation—even air flow—every pump subjected to long test runs before shipment.

LEIMAN Rotary Positive **AIR PUMPS**

Write for new catalog showing construction, types, sizes and specifications, plus Application Book containing many "how-to-do-it" blueprints.

SEE OUR CATALOG IN SWEET'S FILE
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AIR He N

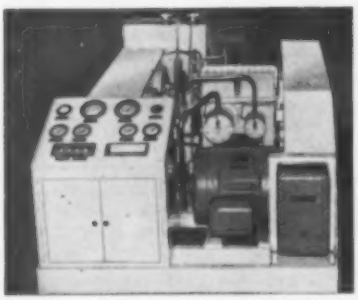
COMPRESSION to
12,000 psi
...discharge capacities
to 150 scfm
with
CARDAIR
CENTRAL COMPRESSION SYSTEMS

New Technical Data and Catalog. See offer below.

Cardair Central Compression Systems (completely packaged, semi-portable)—are today handling air and a variety of gases—helium, nitrogen, argon, etc.—at pressures ranging from 4,000 to 12,000 psi with discharge capacities from 50 to 150 scfm. Even hydrogen is being safely compressed to elevated pressures.

Systems can be provided from stock with *guaranteed* purification of delivered gas to —100°F. dew point and less than 4 ppm oil content. Specially engineered systems to meet your particular requirements can be supplied from standard components.

This ability to control hard-to-handle gases, proven by years of exacting rocket and missile service, offers unlimited possibilities to industry—not only for testing and laboratory work, but also for actual production.



Model PB-CCS—*One of a wide selection of systems* 4-stage air-cooled Compression System—Pressure Range: 6,000—12,000 psig—Induction: 60 to 135 psig—Capacity: 75 scfm N_2 and Air; 70 scfm He—Guaranteed Gas Purity: —100°F. Dew Point, less than 4 ppm oil content.

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Circle **29** on Time-Saver Card

POST SCRIPTS OF INDUSTRY

News about people, manufacturers and sales organizations

Colozzi elected president of U. S. Gasket

Colozzi

Charles C. Colozzi was elected president of the U. S. Gasket Company, Plastics Division of Garlock Inc. He was also elected to the board of directors and will serve as chief executive officer of U. S. Gasket. Colozzi joined the company in 1953. He succeeds A. J. McMullen who is now devoting full time to his position of president and chief executive officer of Garlock, Inc.

Harms appointed chief engineer

Louis C. Harms has joined Fluid Power Accessories, Glenview, Ill., as chief engineer. He was formerly chief engineer of the Aircraft Div. of Waterman Hydraulics Corp.

Vickers makes two appointments

Ray C. Conner, general manager of the Mobile Hydraulics Division, Vickers Incorporated, Detroit, Mich., was elected a vice president of the company. Conner joined Vickers in 1948, was appointed

Conner

Gardiner

general manager of the Mobile Hydraulics Division upon its formation in 1957. Duncan B. Gardiner was appointed manager, corporate engineering for Vickers. After joining Vickers in 1934, he was named chief product development engineer in 1948, assistant chief engineer in 1950 and director of research and development in 1956.

Wilkerson adds two, promotes two

Two executives were added to the Wilkerson Corp. organization. Locke Rowe of Denver was named to the newly created post of Manager of customer relations. C. P. Schmidt assumes the new duties of chief accountant & assistant treasurer. Glenn McEntire was promoted from chief engineer to manager of quality control and W. G. Hill was moved up to chief engineer.

Treffeisen appointed manager of marketing

Treffeisen

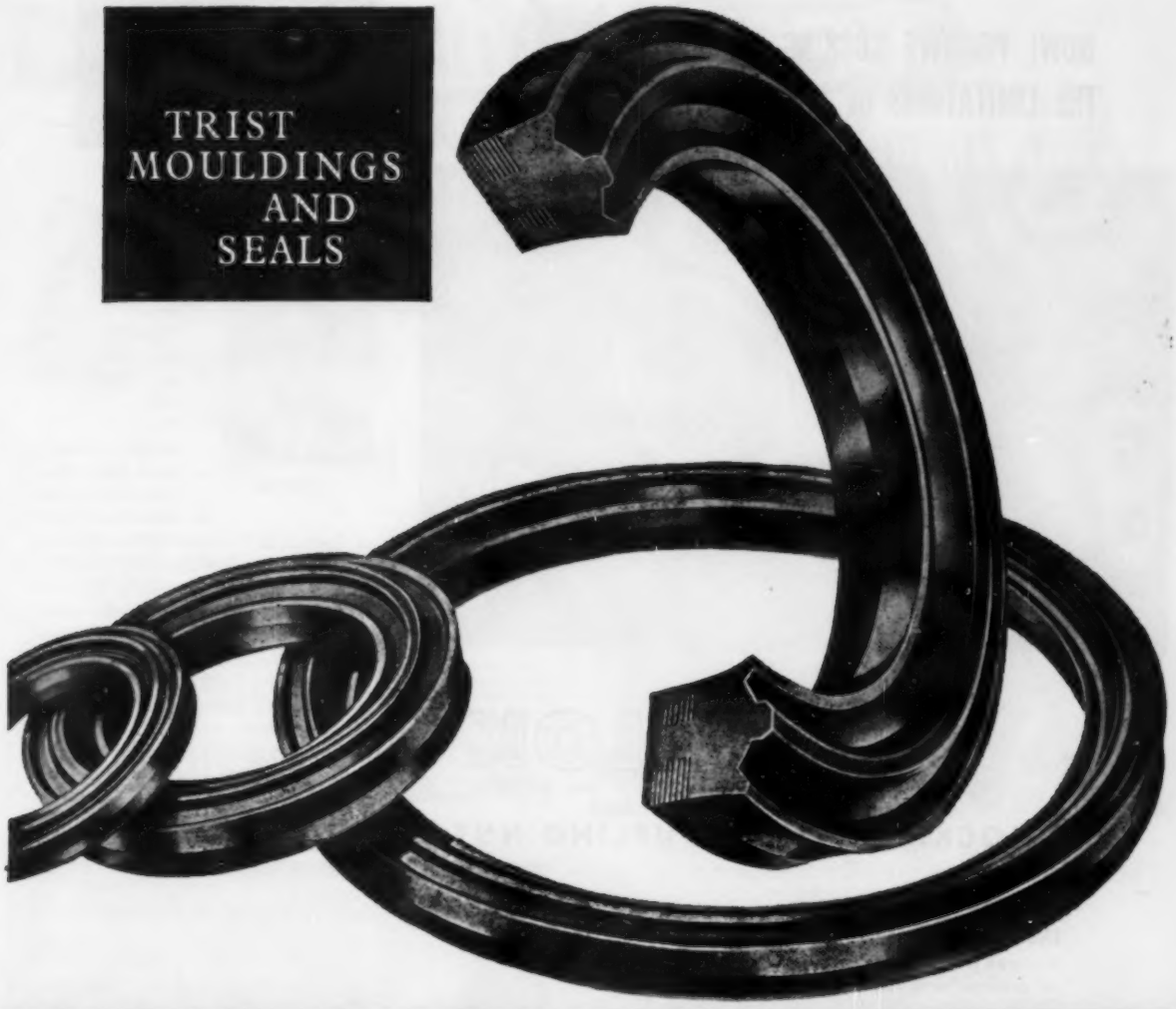
Gus Treffeisen was appointed manager of marketing by the Alemite & Instrument Division of Stewart-Warner Corp. He will direct marketing through distributors and jobbers of Alemite automotive & industrial lubrication products in addition to automotive, marine and industrial gages and instruments.

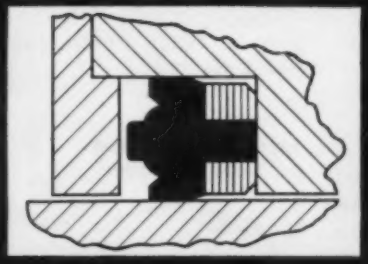
Wilson named western region manager

Bendix Filter Division of the Bendix Corp., Madison Heights, Mich., appointed Brian A. Wilson as western region manager. Wilson, who joined the division in 1959, will operate out of the Van Nuys, California office.

Continued on page 170

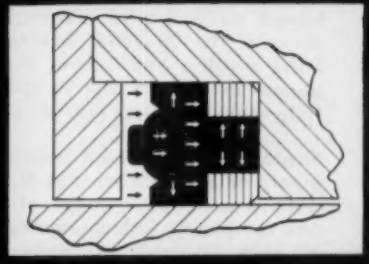
TRIST
MOULDINGS
AND
SEALS





The SCN ring

(Patent No. BP 805253)



A new design of hydraulic seal.

'SCN' rings are the answer to many hydraulic sealing problems not adequately solved by other types of seal. As piston head and rod or gland seals they are effective at pressures as high as 10,000 p.s.i. and will retain "slack" oil at zero pressure. Comprehensive range of standard sizes ex-stock.

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THE LIMITATIONS OF WIRING DEVICES

NEW STRATOLOK
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SELF-LOCKING FLUID COUPLING NUT

Eliminate time and expense involved in safety wiring. The new Stratolok* self-locking fluid coupling nut assures positive locking and trouble-free sealed joints in critical applications.

Stratoflex's new Stratolok series of self-locking nuts is based on a 3-way mechanical displacement of threads. The Stratolok locking element permits free hand starting and insures that the lock is fully engaged before the nut is completely seated. When fully seated, the lock is retained.

Stratolok nuts meet all locking performance requirements of Specification MIL-N-25027. They are available in a complete range of sizes and are reusable and completely interchangeable with existing AN and MS nuts. Stratolok "S" series nuts, for temperatures up to 550°F, are Cadmium-plated steel; "CR" Series, for temperatures up to 800°F, are silver-plated stainless steel. For complete information, write for Stratolok Bulletin S-8.

*Formerly SPS Self-Locking Nut

SF5-0

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Circle 131 on Time-Saver Card

POST SCRIPTS OF INDUSTRY

Parker appoints sales, service personnel

Ballantyne

William E. Ballantyne has been named assistant sales manager, Parker Hydraulics Div., Parker-Hannifin Corp., Cleveland, Ohio. He was assistant sales manager of Industrial Products Div., Cessna Aircraft Co., Hutchinson, Kansas. John E. Sackett, formerly the division's service manager, will work out of Cleveland as district manager of mobile equipment component sales. Taking Sackett's place is Harold E. Lewis, formerly head of distributor sales. William M. Hardy has joined the sales department. He was a sales supervisor for General Tire & Rubber Export Co., Akron. Parker-Hannifin has named Frank W. Cowdrey a sales engineer in the Southern California office. He will handle industrial hydraulic and pneumatic products. He was a resident engineer with Parker Aircraft. Parker Seal Co. has named two representatives. William A. Taylor will work in Pittsburgh and vicinity. Richard Gallmeyer is assigned to southern Ohio, southern Indiana, and Kentucky.

Menster promoted to sales manager

Menster

John A. Menster was promoted to sales manager of Babcock & Wilcox's Tubular Product Division, Alliance, Ohio. He succeeds Leon E. Jeanneret, recently retired. Mr. Menster joined Babcock & Wilcox in 1943 and has been assistant sales manager in charge of welded tubing since 1950. He will retain his headquarters at the Alliance plant.

Continued on page 172

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new ROTORAM® VALVES

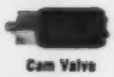
WITH EXCLUSIVE ROTATING STEM

for MILLIONS of TROUBLE-FREE ACTUATIONS

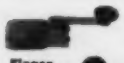
Treadle Valve

Knob Valve

- Low silhouette mounting
- 2024 T4 aluminum bar stock
- Rust-resistant
- Full flow air passages
- Piped exhaust ports
- Interchangeable parts
- Anodized finish



Cam Valve



Finger Valve

Pedal Valve

Hand Ball Valve

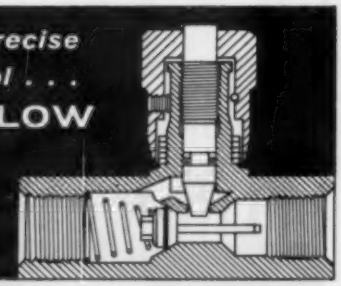
Rotoram Valves are available in 3 and 4-way models for ⅛", ¼", ⅜" and ½" pipe sizes. Special Block "V" Packing permits free ram movement, insures long valve life. Port entry from either left or right side. Ask your AIR-MITE Distributor, or write for complete details and illustrated catalog.

AIR-MITE DEVICES, INC.

4401 W. Kinzie St., Chicago 24, Ill.

For more precise Flow Control . . .

COLORFLOW FLOW CONTROL VALVES



. . . with exclusive color and number calibrated adjustment

- For oil, gas, vacuum, water and other fluids
- Pressures: Brass to 2000 psi Steel to 5000 psi
- Sizes: ⅛, ¼, ⅜, ½ and ¾" dry seal pipe threads

- Simple reading, recording, setting and adjusting
- Safe — adjustable under pressure
- Setting can be locked to hold adjustment
- Extremely sensitive — provides high flow and minimum pressure drop

Write for detailed literature

THE MANATROL Corp.

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BRUNNER SINCE 1906

syn-on-y-mous with dependable air supply

Where dependable compressed air supply is a "must" there's likely to be a Brunner air compressor. Installation after installation proves Brunner air compressors . . .

1. Are outstandingly dependable
2. Offer single or 2 stage equipment in all sizes
3. Supply complete air or water cooled aftercooler assemblies with all fittings from one dependable source for all compressor sizes
4. Provide "entire system" duplex units that are "operation readied" to connect to piping and wiring facilities
5. And the air conditioning and heating experience of Dunham-Bush engineers enables them to professionally assist in layout for dependable control systems.

also **WATER COOLED AFTER COOLERS AND OTHER ACCESSORIES BY heat-x A DUNHAM-BUSH SUBSIDIARY**

REQUEST:

- *Bulletin #763 for water cooled specifications*
- *Catalog #36A for ½ through 20 H.P. data*
- *Catalog #653A for consolidated listings ¼-50 H.P.*

BRUNNER DIVISION

DUNHAM-BUSH, INC.

DEPT. AH, WEST HARTFORD 10, CONNECTICUT

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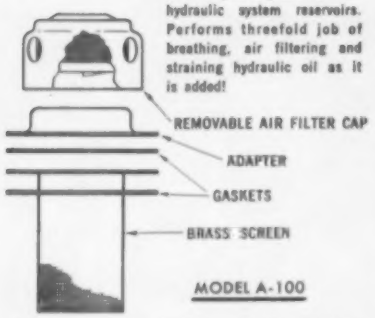
PAUL-MUNROE'S

FILLER-BREATHER

. . . proven-protection for hydraulic system reservoirs. Performs threefold job of breathing, air filtering and straining hydraulic oil as it is added!



PRICE LIST: 1 - 4 $4.00 ea. 10 - 24 $3.10 ea. 5 - 9 $3.50 ea. 25 - 49 $2.80 ea. 50 and up $2.60 ea.

To order or for further information wire or write . . .

POST SCRIPTS OF INDUSTRY

M-H promotes Knoblauch

Minneapolis-Honeywell Regulator Co. has advanced K. Russell Knoblauch to market sales manager of its Industrial Products Group, Philadelphia. He has been in the company's sales organization for 36 years. recently as chemical industry market manager. He will supervise managers for nearly a dozen markets in which sales of industrial products are aligned.

Anderson is Chicago field rep

Air-Maze Corporation, Cleveland, Ohio, appointed Lawrence C. Anderson as Chicago district field representative. His sales territory includes Illinois, Indiana, Missouri and other midwestern states.

Periflex absorbs Kalendex Corp.

Periflex, Inc., Hazel Park, Mich., will now operate the former subsidiary under the name of Kalendex Division. Kalendex was acquired by Periflex in 1958. Gene Pillar remains general manager of the division and is technical director for the parent company.

Zaruba to manage Cleveland plant

Zaruba

Harry A. Zaruba was appointed Manager of the Cleveland plant of Le Roi Division, Westinghouse Air Brake Co., Milwaukee, Wisconsin. Zaruba is returning to the plant he left in 1959 when he went to Le Roi's operation in Milwaukee. He started with the Cleveland Pneumatic Tool Co. in 1942 and remained with the company when Le Roi acquired it in 1946.

Continued on page 174

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FREE
Technical Bulletin Service
shows how to solve toughest problems!
it takes 2 modern types of retaining rings to solve all of your retaining ring problems
—AND—
only RAMCO has BOTH!
the 360° coil-formed ring SpirOlox
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Without cost or obligation, put my name on your Technical Bulletin Service list and send your latest Catalog.
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The Most Compact Solenoid Valve in the Fluid Power Control Field...
VERSA SERIES "A"
Manifold Model with sub-plate
Side-port Model
Versa's new four-way solenoid valves measure only 5½" high by 1⅝" diameter, yet have a full 3/16" diameter flow area. Completely corrosion-resistant and simple to install, Versa Series "A" solenoid valves are available in over 100 different variations. Triple pressure and functionally tested under water for guaranteed leakproofness.
VERSA
VERSA PRODUCTS COMPANY INC.
130 A COOLIDGE AVENUE
ENGLEWOOD, NEW JERSEY
Write today for your free copy of Bulletin #1259

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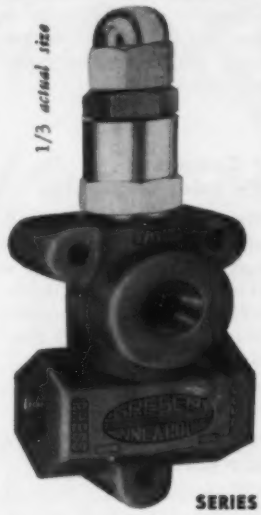


TWO NEW RELIEF VALVES

GRESEN HYDRAULICS

SERIES J (*High-lift ball and spring type*)
ONLY $16.50*

SERIES PJ (*pilot operated*) **$19.50**

Both series feature unique design for minimum *crack* to *full-flow* pressure differential and smooth, quiet operation. Both series, designed for *in-line* mounting, are available in ¾" and 1" pipe sizes and ¾", ⅞", and 1" tube sizes. Pressure adjustment range: 400-2500 psi for the PJ series, 400-2000 psi for the J series. Capacities up to 40 gpm (PJ series), 16-38 gpm (J series).

**Prices are FOB Factory and subject to trade discounts*

WRITE FOR LITERATURE

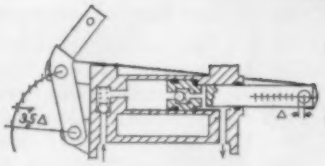
GRESEN *Mfg. Co.*

405 35th Ave. N.E., Minneapolis 8, Minn.

Tog-Oil®

DOUBLE ACTING DIFFERENTIAL PLUNGER HAND PUMP

Uses Only Two Check Valves



- For even increments of piston movement, handle movement increases at left end of stroke
- Mechanical advantage 3.5:1

Model 1772 has ½ gallon reservoir, needle type release, and safety valves for 1000 to 2000 P.S.I. Other models available for pressures to 10,000 P.S.I.

We also manufacture

- Kingsbury Slipper Type rotary hydraulic pumps for pressures to 2000 P.S.I.
- Hydro-wheels for self-propelled lifters, with 360° steering and reverse.

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MECHANISMS, INC.

118 EAST 2ND ST. • UHRICHSVILLE, OHIO

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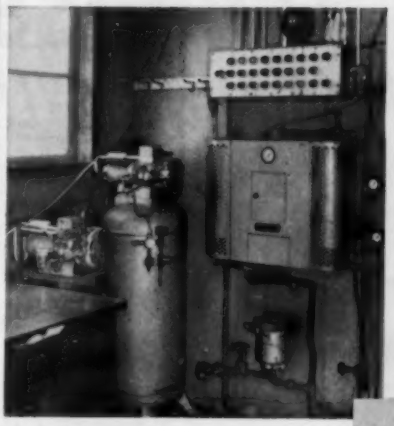
B&G MOTOR COMPRESSOR
1/12 to 3/4 H.P., up to 6.5 CFM, up to 190 psi.

ON-THE-SPOT *Oil-less* COMPRESSED AIR FOR INSTRUMENT CONTROL



30 gal. A.S.M.E. Air Tank Outfits
75 and 175 lb. units.

10 gal. Air Tank Outfits. 35, 75, 135 lbs. units mounted on non-code tank. 75 and 175 lb. units available with A.S.M.E. Code tanks.

For instrument control with compressed air, patented B&G Oil-less Compressors offer outstanding, exclusive advantages.

They deliver air *completely oil-free!* Carbon-graphite piston rings and skirts need no lubrication; bearings are grease-packed and sealed for life. Numerous design and construction features assure dependable delivery of cleaner, cooler, drier air and smoother operation.

B&G Oil-less Compressors can be located at the site of the control, eliminating long pipe lines which may contaminate the air with dirt and condensation.

58 Models to choose from — tank mounted, portable, motor and gas engine driven.

For complete information on B&G Oil-less Compressors and Vacuum Pumps, send for Catalog GO-1156.

B&G

***Oil-less* AIR COMPRESSORS**

BELL & GOSSETT COMPANY

Dept. GI-66, Morton Grove, Illinois

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POST SCRIPTS OF INDUSTRY

Pearse-Pearson Co. in new home

The Pearse-Pearson Company has occupied its new office and warehouse at 22 Tobey Road, Bloomfield, Conn. Established in 1936, the company represents several hydraulic and pneumatic equipment manufacturers in the New England area. Repair and test facilities will soon be available for pumps and valves through the use of a large function block hydraulic analyzer.

Pauler joins Owatonna

Owatonna Tool Company, Owatonna, Minn., appointed Francis Pauler as industrial sales engineer. Pauler will work closely with mobile equipment manufacturers in the design and application of special manual and hydraulic maintenance tools.

Rucker Company appoints sales engineers

The Rucker Company, Oakland, California, appointed Alan Grant Hughes as inside sales engineer at the Oakland headquarters office. Max C. Thompson has been added as inside sales engineer to the firm's Portland, Oregon office.

Dix named S. California rep

Samuel Moore & Co., Mantua, Ohio, appointed G. William Dix as southern California representative for both the Dekoran Products and Synflex Products divisions.

Automatic Valve names Chorkey

William J. Chorkey recently joined the Automatic Valve Co. as director of sales & engineering. He will coordinate activities of these groups.

Chorkey

Crowley

Crowley now district manager

James J. Crowley was promoted to district manager of the New York and Washington sales territory of Air-Maze Corp., Cleveland, Ohio. Herbert C. Brodsky was named factory representative to handle the company's sales and field engineering activities in south and central Michigan.

Test laboratory acquired

Testing, Inc., Los Angeles, which performs qualification and research tests on hydraulic and pneumatic components and systems has been purchased by Idaho

Continued on page 176

ON THE JOB...

with CROSS HYDRAULIC CYLINDERS

Stay "on the job" with dependable, rugged Cross Hydraulic Cylinders. Like Cross customers everywhere, you too, will appreciate the fast, courteous, dependable service you get from Cross. Phone for speedy delivery on any quantity...quality-built to your specifications. Contact Gross Engineering Department, today!

- RUGGED
- DEPENDABLE
- ECONOMICAL

CUSTOM DESIGNED CYLINDERS FOR EVERY APPLICATION

Try CROSS CYLINDERS in your operation... low cost, dependable, and trouble free.

Lowest-Priced Engineered Quality Cylinders Available..

trade mark of Quality in Hydraulic Cylinders...

HYDRAULIC CROSS CYLINDERS

CROSS MANUFACTURING CO.
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WRITE • WIRE • PHONE...TODAY!!

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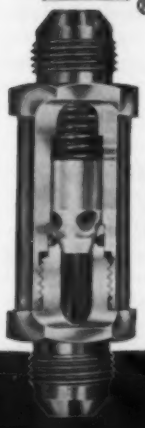
Circle **80** on Time-Saver Card

Kep-O-seal



Flexible Seal Seat * VALVES

- **CHECK VALVES**
- **RELIEF VALVES**
- **SHUTTLE VALVES**
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Mark IV—5 cylinder 4,500 lbs. ft. at 2,000 p.s.i. (Speed 1-100 R.P.M.) **Mark V**—7 cylinder 6,600 lbs. ft. at 2,000 p.s.i. (Speed 1-75 R.P.M.) Overall efficiency 90% to 95%.
Ideal drive for conveyors, rolling mills, cranes, tractors, drills and most mechanical handling applications.
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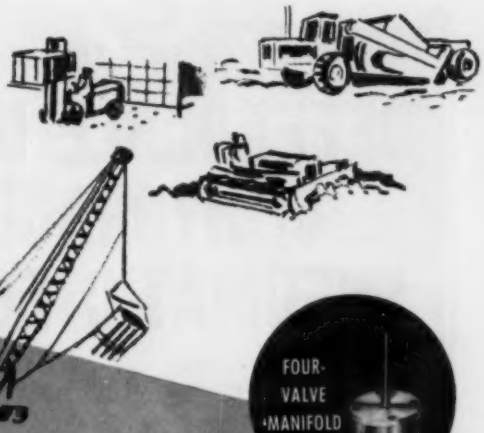

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... lightens the work and speeds the job!

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These new Humphrey air control valves, with their small size, low current consumption, large capacity and quick response, have encouraged greatly increased use of compressed air "assists" — for steering, braking, shifting gears, piloting high pressure hydraulic, and many other operations.

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have low coefficient of friction

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for use from ounces to thousands of pounds psi

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Page Packings — engineered to do a better job

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POST SCRIPTS OF INDUSTRY

Maryland Mines Corp., Glendale Calif. It has been reorganized as Universal Research and Testing Laboratories. It will add facilities to test more complex units under extreme environmental conditions. Elmo T. Evans has been appointed general manager; Charles Adamovic, chief test engineer; and James McGonigal, customer relations manager.

S-P Mfg. elects officers

S-P Manufacturing Corp., Solon, Ohio, elected Merritt B. Sampson vice president, engineering, and Richard E. Sutherland vice president, sales. Re-elected were H. Lee Bassett, president and treasurer; D. Lee Bassett, executive vice president; Robert C. Grossman, secretary; Richard H. Stewart, assistant secretary and J. Walker Fickes, assistant treasurer.

Two join Fauver

David E. Paul, sales engineer, has joined the Indianapolis office of J. N. Fauver Co., Inc., Detroit, Mich. He will represent the company in the state of Indiana. David R. Evans has joined the Cincinnati office, covering the Columbus-Cincinnati area.

Fluid Regulators names sales manager

Fluid Regulators Corp., Painesville, Ohio, appointed Joseph R. Maslove, Jr., as sales manager. Prior to joining Fluid Regulators he was sales engineer and assistant to vice president of sales, Ohio Rubber Co.

De Laval appoints southwest sales rep.

Wayne Patterson was named by De Laval Separator Company as sales engineer for Oklahoma and north and west Texas. He will headquarter at Dallas. Patterson was previously with Fairbanks, Morse & Co.

Two regional sales managers named

Richard D. Durrett was named New York Regional Sales Manager of Sealol, Inc. Joining the company in 1953, Durrett served as sales engineer for Sealol in Kansas City, Philadelphia, Tulsa, and Dayton, Ohio. Royce Johnson assumed the duties of western regional sales manager. Prior to going to Sealol, Johnston was a senior research engineer with the Rocketdyne Division of North American Aircraft.

Ezekiel appointed director of research

American Measurement & Control, Inc., has appointed Dr. F. D. Ezekiel its Director of Research. Prior to joining the company, he was assistant professor of Mechanical Engineering at M.I.T. and recently served as Associate director of the 1960 Summer Course in Fluid Power Control. He is the author of many papers on fluid mechanics & controls and contributed to the recently published book Fluid Power Control. Dr. Ezekiel has extensive experience in the fields of pneumatic control systems, hydrostatic bearing applications, and dynamic aspects of valve design.

Ezekiel

Nork

Fuller Co. transfers Nork

The Fuller Co. has tranferred James J. Nork from the San Francisco to the Los Angeles district office. Nork will handle sales & service of Fuller equipment in his new location.

New distributors

The Parker-Hannifin Corporation, Cleveland, Ohio, announces that *Ellis Akin Engineering Co.*, Kansas City, Mo., will distribute industrial tube and hose fittings made by the Parker Fittings & Hose division, and hydraulic cylinders made by Hannifin Co. division

Continued on next page

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CHECK BM VALVES

Specify the very best !

ULTRA PRECISION

DISC TYPE—0.5 PSI CRACK AVAILABLE TO .06 PSI CRACK VERY LOW BACK PRESSURE

ONE PIECE BODY

DISC TYPE, 2—8 PSI CRACK ¼—⅜—½ F.P. BRASS HIGH PRESSURE—LEAKPROOF

ONE PIECE NIPPLE

DISC TYPE—2 PSI CRACK ¼—⅜—½— M.P. BRASS EXCELLENT FLOW—LEAKPROOF

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CUSTOM DESIGNED AND BUILT CHECK VALVES FOR HUNDREDS OF INDUSTRIES—QUANTITY PERMITTING

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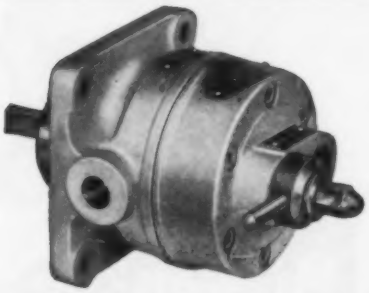
23 BEECHWOOD AVE. MT. VERNON, N. Y.



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for FINE METERING PURPOSES

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Bourdon tubes of bronze, drawn or bored s/s, and other alloys

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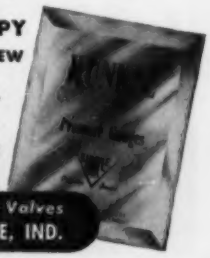

By the makers of dependable Kunkle Valves
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POST SCRIPTS OF INDUSTRY

in Des Plaines, Ill. *The Railway & Power Corp. Ltd.*, of Toronto and Montreal and *Livingston & Haven, Inc.*, Charleston, South Carolina, will distribute the Crown air line of Hannifin Co. *Dupar Dynamics Corp.* of Hayward, Calif., Portland, and Seattle, has been franchised to carry industrial tubes and hose fittings, the Crown air line, and hydraulic cylinders.

Hydra-Tec Corp., Great Neck, Long Island, N. Y., will distribute and service Sprague Engineering Corporation's industrial products in lower New York, upper New Jersey, and lower Connecticut.

Linear, Inc., Philadelphia, Pa., has appointed six distributors to handle its line of seals and mechanical packings. In Chicago, *Product Sales and Engineering Co.* will cover the Chicago area. On the West Coast, franchises were assigned to *Calkins Mfg. Co.*, Spokane, Wash. for the eastern part of the state and *Intercontinental Aviation Services*, Los Angeles, Calif. for export to England, Germany, France, Belgium and other European countries. *The Kindred Aviation Co.* of Burbank, Calif. will act as exporter to 35 foreign countries. *Landes, Zachary & Petersen Co.*, Denver, will service Colorado, southwestern Wyoming, New Mexico and the El Paso, Texas territory. *Dascomp Aircraft Supplies*, Seattle, Wash., has been named to export to western Canada, Alaska, and Japan.

The Nopak division of the Galland-Henning Mfg. Co., Milwaukee, Wisconsin, announces the appointment of *Owens-Richards*, Birmingham, Alabama, as its exclusive representative in that state.

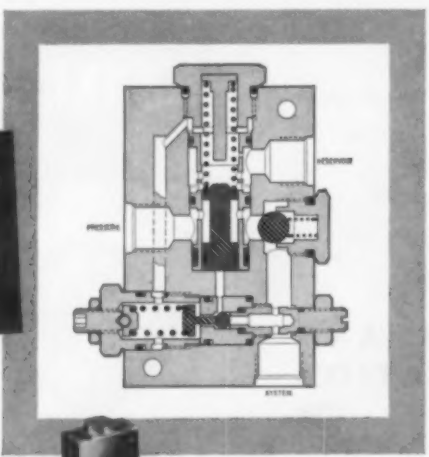
Shaltz Engineering Co., Flint, Michigan, will be the representative for Hydro-Line Manufacturing Co., Rockford, Ill., makers of high and low pressure hydraulic cylinders, intensifiers, and new self-aligning rod end couplers.

Le Roi Div., Westinghouse Air Brake Co., Milwaukee, has named two companies to distribute Le Roi S2 stationary compressors and tank-mounted, Unit-type Westinghouse compressors. They are *Wheel Industries, Inc.*, Los Angeles, and *Central Air Compressors Co.*, Detroit.

Hanna Enginnering Works, Chicago, Ill. has named the *Hughes Industrial Products Inc.*, Buffalo, New York, to represent them in the Buffalo area.

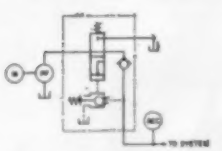
Controls Both Load And Unload Pressures . . .

NEW Unloading Valve



Typical Accumulator Circuit

Size — ½" SAE Ports



Exclusive Features . . .

- Unload pressure adjustable — from 800 to 3,000 psi.
- Load pressure independently adjustable — 5% to 20% differential.
- Positive snap action — assures complete loading and unloading.
- Built-in check valve and integral pilot save money.

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- Two-Pump, Hi-Lo Circuits
- To Vent Relief Valves

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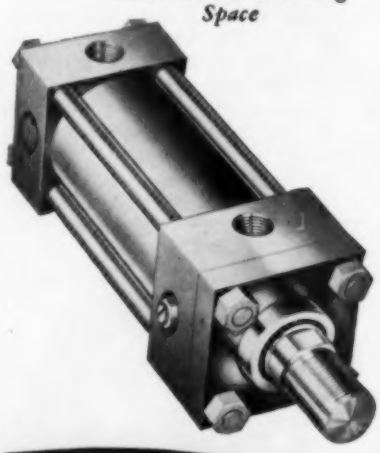

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Southern California's fastest growing distributor of fluid power equipment, PAUL-MUNROE HYDRAULICS, requires sales-application engineers. Distributes major lines —Airoyal, Anchor, Berry, Dowty, Dukes, F.P.A., Greer, Helicoid, Hyco, Perfex, Ripley, Rivett, Weatherhead, Wisconsin—protected territory, commission plan, car furnished. Our J. E. Munroe will be in Chicago on September 16 and 21 to interview. Send resume prior to this date to J. E. Munroe, c/o Paul-Munroe Hydraulics, 420 East Seventh Street, Hinsdale, Illinois.

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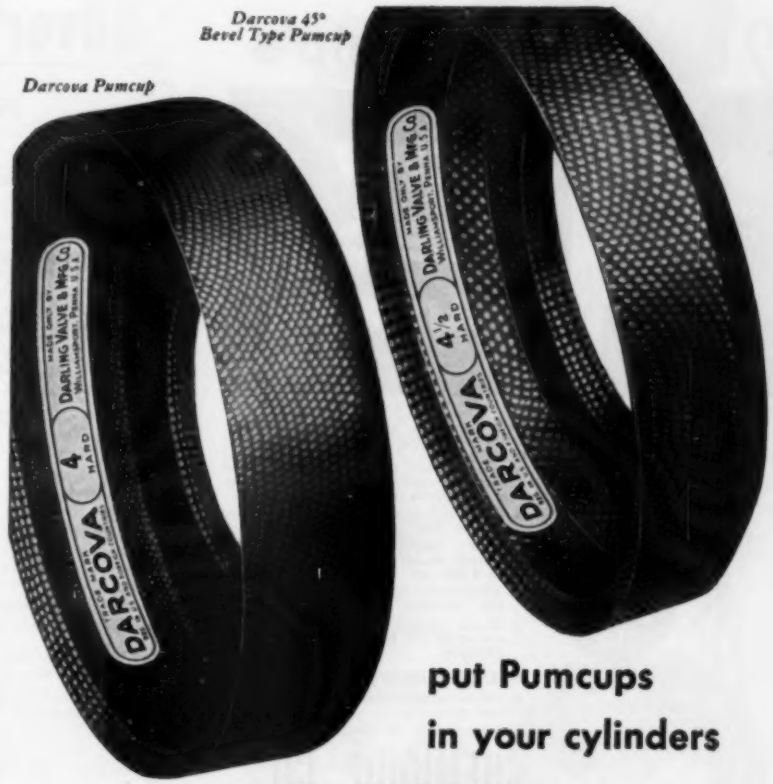
Darcova 45° Bevel Type Pumcup

Darcova Pumcup



put Pumcups in your cylinders

TO HOLD PRESSURE LONGER!

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Unlike ordinary piston packing, precision Pumcups are engineered to minimize friction load while hugging cylinder walls on every pressure stroke. Regardless of eventual wear, efficiency *stays* high! So there's far less down-time and need for replacement.

Pumcups are made in a wide range of sizes, types and texture-engineered compositions, including 100% Nylon, for all kinds of pressure-temperature-fluid conditions. Send for Pumcup Bulletin 5903 and weigh all the facts!

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DARCOVA — THE ORIGINAL COMPOSITION CUP

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a NEW concept in PRESSURE INSTRUMENT PROTECTION

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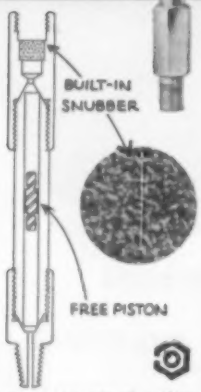

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- Will withstand pressures up to 30,000 psi
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- Prevents transmission of line surges and pulsations
- Never plugs or clogs

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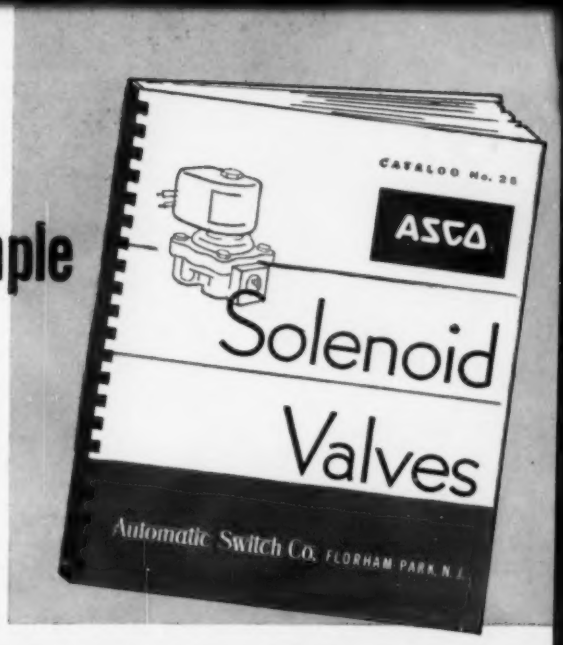
ASCO makes Solenoid Valve selection simple



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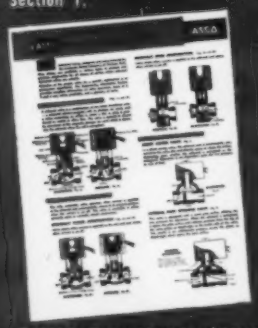

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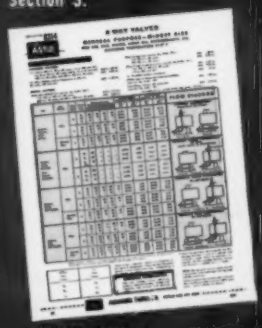
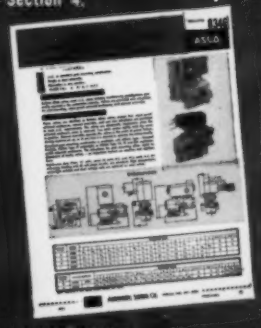


3-WAY VALVES
Detailed information on fully automatic valves for pilot control of diaphragms or cylinders, or for diverting flow in pipelines.

Section 4.



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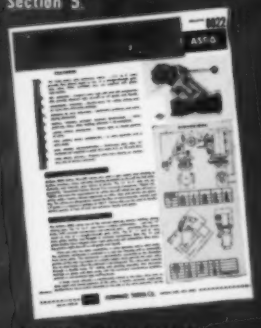

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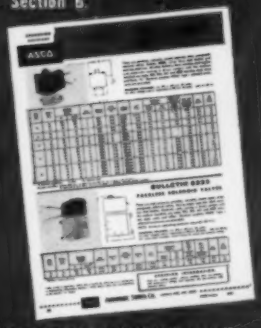
Section 6.



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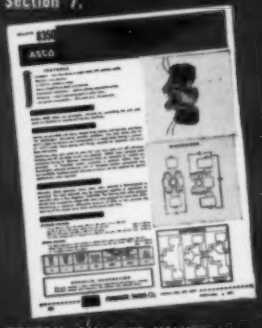
Section 7.



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